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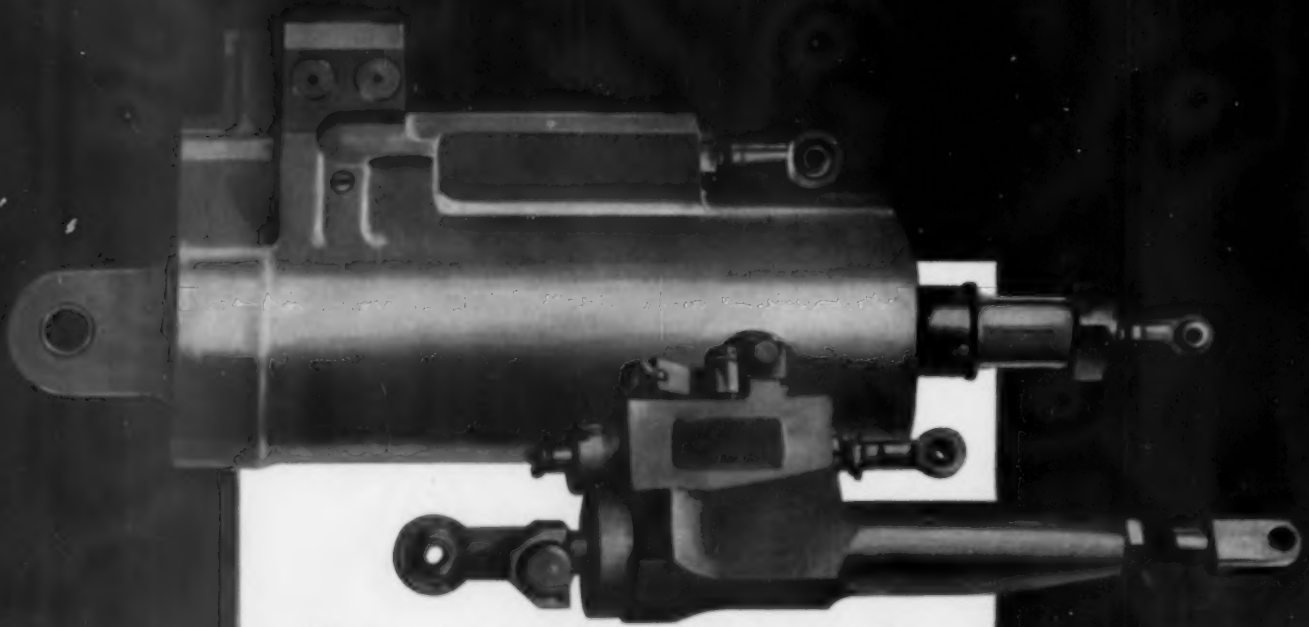

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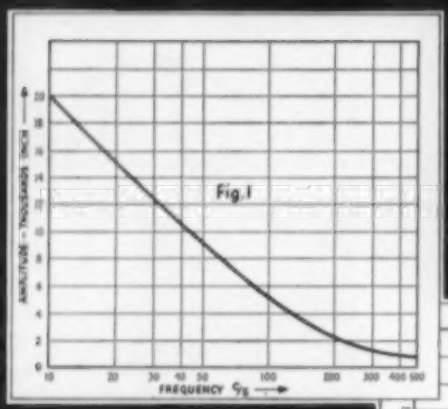
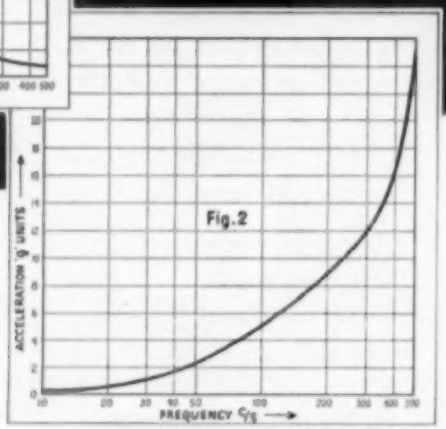


that a vibration amplitude of ·001" at 500 c/s represents an acceleration of about 25 'g'



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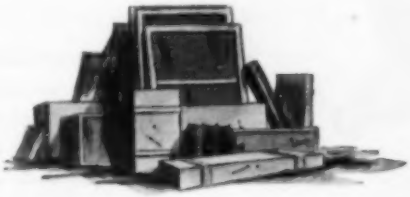

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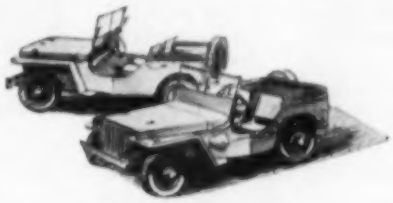

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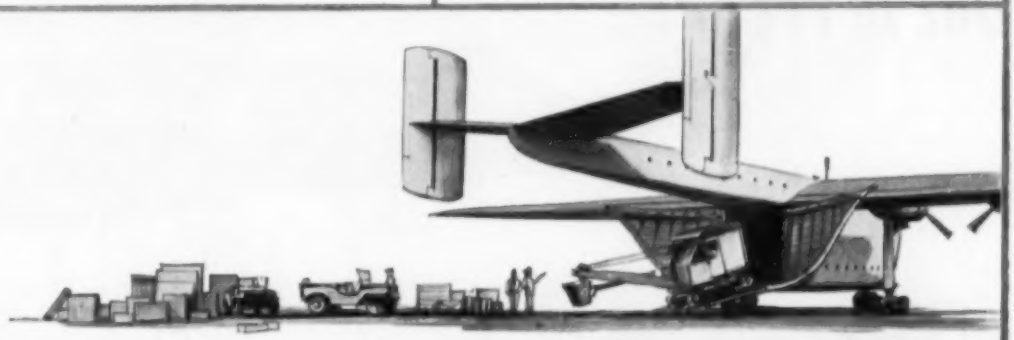

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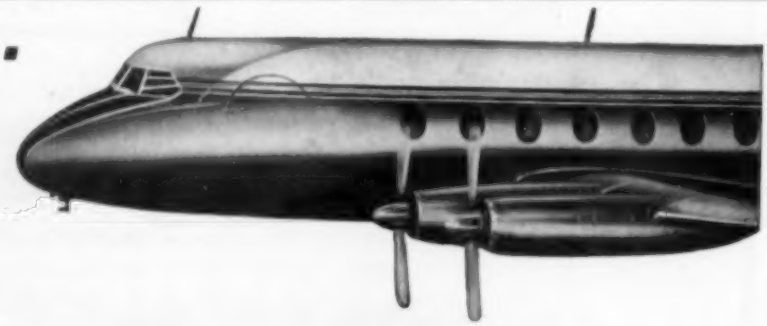

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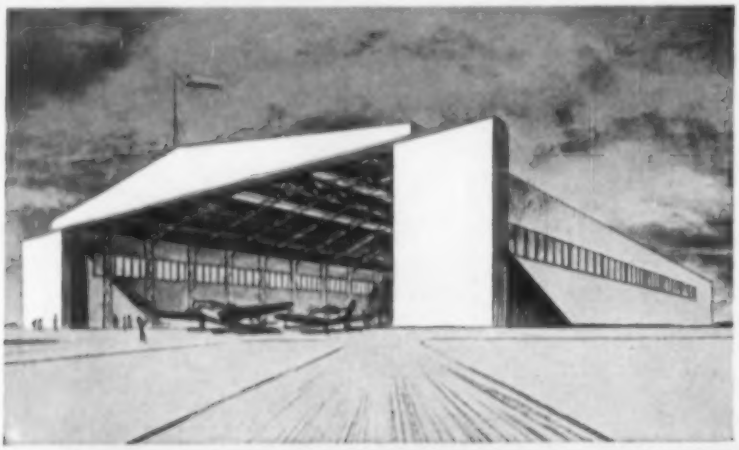

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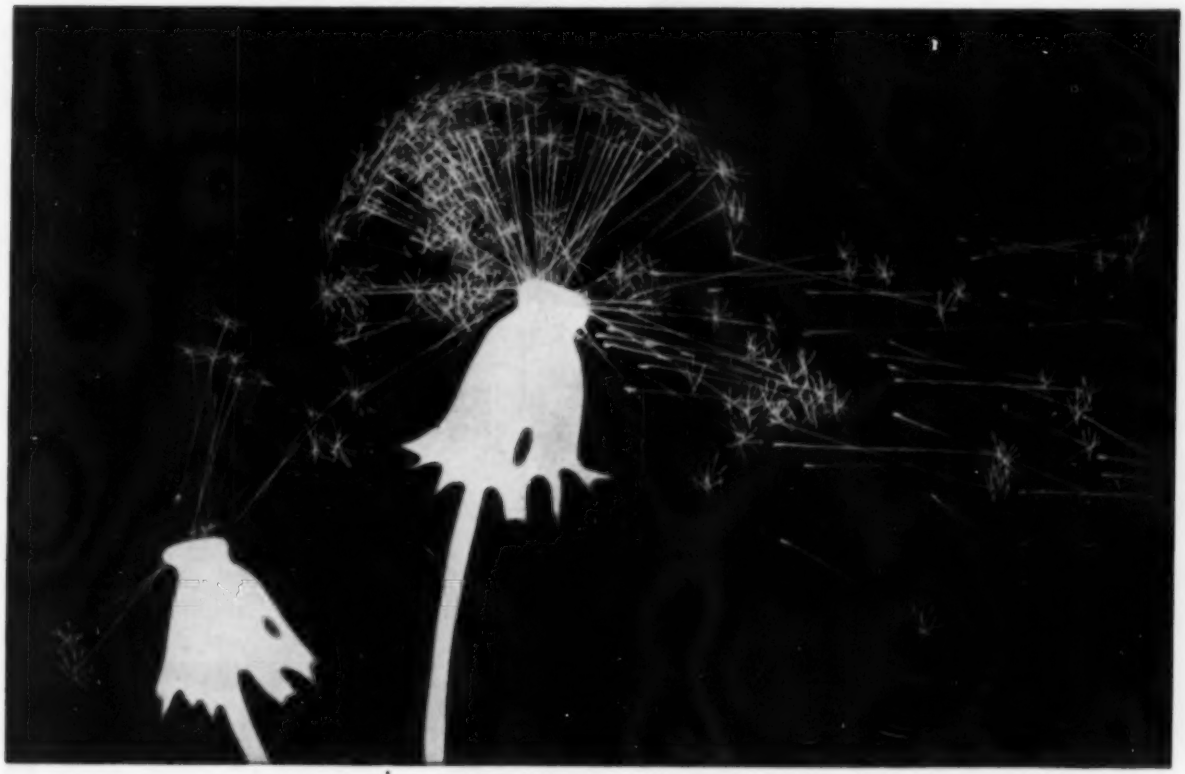

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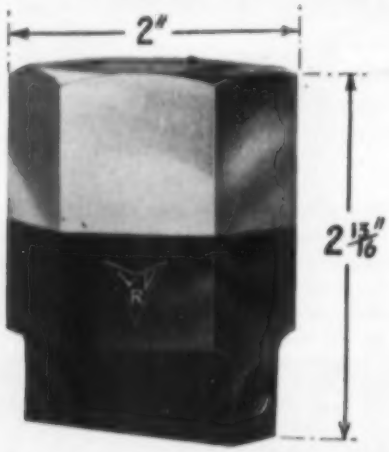

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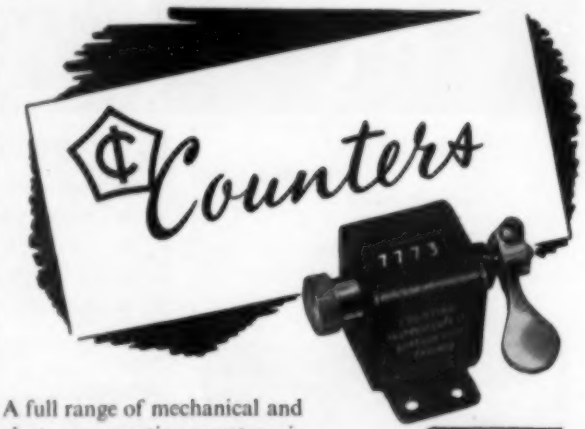

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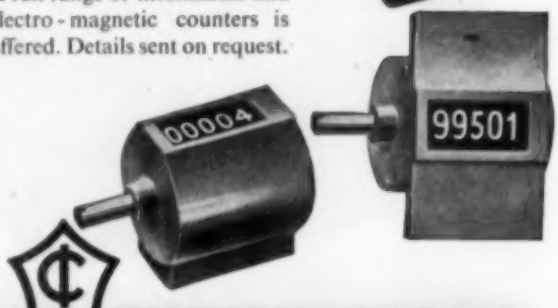

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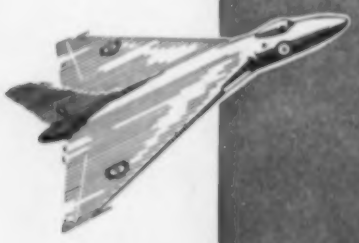

Avocet photographed by Eric Hosking.
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FLIGHT
and
AIRCRAFT ENGINEER

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Founded 1909

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Transonic Policy

THAT the United States Air Force and Navy now have supersonic fighters in service is partly due to a particular discovery—the subject of an article in this issue—by American aerodynamicists. By corollary, it might be inferred that lack of this knowledge has denied similar machines to our own Services.

Known as the area rule, the new formula has allowed the Grumman Corporation to build a carrier-based fighter which easily exceeds Mach 1 in level flight on the power of a single American-made Sapphire turbojet (an afterburner is fitted, but Mach 1 is reached without its use). This turbojet is also used in British fighters, in which it gives at least as much thrust as is available to the Grumman design; yet our machines reach Mach 1 only in a dive.

Briefly, the area rule enables the designer of a supersonic aircraft to obtain the best distribution of cross-sectional area; from calculations he can draw the optimum shape for a given performance. The projected machine is theoretically sliced up, and its cross-sectional area—including wings, tanks and external stores—compared with the optimum; adjustments are then made as necessary. In practice this may mean "waisting" the fuselage to compensate for the adjacent wings (and any appendages) or extending or swelling the nose or tail, or both, in order to preserve the overall shape. The result is not always pleasing to the eye. Bulges beside a jetpipe in a tail that diminishes rapidly in cross-section look entirely wrong; yet area-rule experience shows that, aerodynamically, they make sound transonic sense.

No official information has yet been released about the adoption of the area rule in this country, or about the industry's attitude to it. So great is its importance that, following public revelation in America, an official pronouncement here might have been expected. None has yet been made.

There is no doubt that our designers have been acquainted with the area rule for some time past; yet the British taxpayer has not been told of any home-produced "area ruled" aircraft. By simple calculation it is not difficult to see that some of our designs, such as the Gnat, are extremely near to the right shape. Meanwhile, it is tantalizing to apply area rule to existing R.A.F. machines and to calculate what a useful increment in performance it could have conferred.

Where Will it Stop?

IN support of the International Association of Machinists, which has been engaged in a wages dispute with the Flying Tiger Line, trade unions at London Airport recently imposed a ban on the servicing of aircraft belonging to this American air-freight and charter company. Last week the secretary of the trades-union side of the British National Joint Council for Civil Aviation announced with satisfaction that the ban had been "operated 100 per cent" by the unions.

In a letter to the International Transport Workers' Federation, this official expressed his concern that not only had "aircraft of this line been serviced in other parts of Europe" but that "other non-British airlines have instructed their employees to service these machines, and this may lead to the British civil aviation workers taking action against those European airlines who service 'black' machines if they happen to use British airports . . ."

We must admit that we do not know all the details of the dispute between the Flying Tiger Line and its employees. Moreover, we would confess to the belief that America's labour disputes, like her politics, are matters primarily of domestic concern. London Airport's trade union leaders apparently think otherwise. This is not the first occasion on which they have attempted to influence matters far beyond their accepted terms of reference. The Flying Tiger ban might not have any serious repercussions, because the airline normally operates in North America and makes only occasional charter flights to Europe; but the implied threat is profoundly disturbing. That dockers adopt similar tactics is an unconvincing defence. In this expanding industry, such restrictive actions are far more likely to create new problems than to solve existing ones.

FROM ALL QUARTERS

Britannia Trials Continue

FOR the third of its current series of overseas proving flights, which began on September 9th, Britannia G-ANBC visited Tripoli. Previously, it had made two round trips to Johannesburg. The main purpose of the Tripoli flight was to make a practical test of the cabin atmosphere system. The aircraft flew out with 98 people on board, consisting of a crew of 13 (this unusually large crew included several B.O.A.C. Britannia Fleet members under training) and 85 employees of the Bristol Aeroplane Co.

The Britannia left London Airport just before 2 a.m. G.M.T. on September 21st and landed at Idris at 6.39 a.m. The total distance of 1,518 statute miles was covered in a chock-to-chock time of 4 hr 55 min (on-course time was 4 hr 37 min, giving a speed of 332 m.p.h.). Cruising altitude was 23,500ft for the first half of the flight, 25,500 for the second. Maximum ground-speed observed during the journey—between Dijon and Turin—was 362 m.p.h.

Throughout its stay at Idris, where shade temperature was 93 deg, the aircraft stood in the sun. When passengers went aboard for the return trip, the temperature in the aircraft was over 90 deg, but it dropped to comfortable level within about 10-15 min of take-off. Technicians took temperature readings at various points in the cabin, recording the temperature-drop, and on the outward flight a number of sound-level readings.

The log of the return flight was as follows: chocks away at Idris, 14.57 G.M.T.; arrival at London Airport 20.22 G.M.T.; on-course time, 5 hr 3 min; average on-course speed, 305 m.p.h. (over a slightly longer course); altitude, level flight at 22,500ft.

On September 24th the Britannia made a day-trip to Berlin, carrying Mr. Peter Thorneycroft, President of the Board of Trade. Mr. Thorneycroft, who was opening the British section of the West Berlin Trade Fair, described the Britannia as "in itself a wonderful showpiece for Britain."

Piloted by Bristol test-pilot Walter Gibb, G-ANBC set off again on September 26th for Entebbe. It was due to return on September 28th. The purpose of this journey was to make a ten-hour flight from Entebbe at 16,000ft in search of icing conditions. The equator area was chosen for the test since, it was stated, icing conditions are more severe there during the rainy season than would normally be encountered nearer home. A photograph of G-ANBC at Nairobi appears on page 565.

Helicopter "Invasion Force"

THE annexation by the Royal Navy of the Island of Rockall—a 70ft-high rock 290 miles out in the Atlantic from Scotland—received plenty of publicity last week; and certainly the landing, by four men from the survey ship H.M.S. *Vidal*, was a considerable feat. (The quartet consisted of a Naval officer, two Royal Marine Commandos, and a civilian ornithologist.) It is, however, a fact—as the record of a few orthodox landing attempts during the past 100 years shows—that the achievement would have been virtually impossible without the use of a helicopter.

The party was winched down on to the rock from a Dragonfly flown by Lt. R. Leonard, who made, in all, 11 flights carrying men and gear and was airborne for a total of 1 hr 43 min. The operation was performed in about three hours of "calm" weather between gales (10ft waves were breaking against the rock) and the Dragonfly pilot had a ticklish job in putting his aircraft down on *Vidal's* flight deck, which measures only 33ft by 33ft (normally, it accommodates a Hiller).

Fourth Order for Viscount 800s

AN order from Fred Olsen Airtransport, Ltd., for three Viscount 800s was announced last week. The aircraft, with the type-number V.805, will be delivered in 1957. This Norwegian independent airline had previously ordered three V.700-Series Viscounts, two of which have been completed and are on lease to B.E.A. The order is the fourth to be placed for the V.800-Series Viscount, other purchasers being B.E.A. (22), K.L.M. (9) and Transair (2); it brings the total number of Viscounts (of all types) sold to 239.

M.o.S. Appointment

THE Ministry of Supply announces that Dr. W. B. Littler has been promoted to chief scientific officer and appointed Principal Director of Scientific Research (Defence) in succession to Dr. Cawood, who is to become Principal Director of Scientific Research (Air) on November 1st, 1955.

SeaMaster Progress

SINCE its first flight on July 14th, the prototype Martin XP6M-1 SeaMaster—new pictures of which appear here—has logged considerably more than 25 flying hours, and is regularly carrying out test flights of 1½ to 3 hours' duration. On its first flight, the crew comprised George Rodney (chief of Martin experimental flight testing), Morris Bernhard (assistant pilot), Herbert Scudder (flight engineer) and H. B. Coulon (flight test engineer). Rodney described this first flight as "very, very uneventful," and stated that although the XP6M logged no less than an hour and 40 minutes, he only decided to land when the various recording cameras had run out of film. Mr. George M. Bunker, Martin president, has pointed out that the test programme is proceeding even better than was originally planned.

Coupled with this announcement are several dimensions of the XP6M hitherto not cleared for publication. They include: span

WELCOME DEFENDER: soon to equip squadrons of the 1st Air Division, R.C.A.F. in Europe, the Avro Aircraft CF-100 Mk 4 will be a most useful all-weather machine in this theatre. This example is one brought across earlier for handling trials at West Raynham (and, in passing, for display at Farnborough). The background to this fine study is the western end of Isle of Wight; in the distance is the mainland.

"UNUSUALLY PROMISING" is the verdict passed upon the Martin XP6M SeaMaster high-speed flying boat by its purchasers, the U.S. Navy. These new photographs are supplemented by a news-item on this page.

100ft, length 134ft, height 31ft, hull width 10ft, total wing area 1,900 sq ft, and vertical tail area 213 sq ft. Power is provided by four Allison J71 turbojets, the normal 10,000 lb static thrust of each being boosted by some 40 per cent at take-off by the use of afterburners. On tactical missions, the XP6M will carry a payload of 30,000 lb, and it is equipped with a watertight rotary door (similar in principle to that used on the Martin B-57 Canberra) on which a variety of weapons can be mounted. The operational crew consists of pilot, assistant pilot, navigator/mine layer, radio operator and armament defence operator.

The Navy and Martin have also released first news of two new developments required for the operational handling of SeaMasters. The first is a beaching vehicle which will enable the SeaMaster to proceed up its ramp under its own power. The first beaching vehicle will be ready for testing late this year. The other device is a service and dry dock facility for use in semi-sheltered areas in conjunction with seaplane tenders. The dock will remain partially submerged and a series of individually operated hull pads will be raised to secure the aircraft. Under-water air bags will be inflated to raise the dock to the servicing position and hydraulic, electric and pneumatic power will be provided, together with booms for loading or engine changing.

C.D. Helicopter Post

Chief Inspector Watson

LAST week we reported the charter of a Whirlwind helicopter by the Home Office from B.E.A. for experimental Civil Defence duties, and now comes news of the appointment of Inspector Norman Watson of the Nottingham City Police to take charge of helicopter instruction in connection with Civil Defence for the entire country.

Inspector Watson joined the R.A.F. in 1941 and served in Bomber Command, where he was awarded the D.F.C. Demobilized in 1945 with the rank of squadron leader, he rejoined the Nottingham Police and a year ago was made head of the accident prevention department.

The Midge Lost

THE Folland Midge prototype was destroyed in an accident near Chilbolton, Andover, last Monday morning while being taken off by a Swiss officer, a member of a delegation visiting the maker's works. The pilot, Maj. Max Mathez, lost his life.

Powered by an Armstrong Siddeley Viper of 1,640 lb thrust, the Midge was the first of the two Folland light fighters. Its successor is the Gnat, powered by a Bristol Orpheus engine of 3,285 lb thrust and of proportionately higher performance.

By a coincidence, news of a happier nature, this time concerning the Gnat, comes from India. A Bombay correspondent reports that following the recent visit to England of India's Defence Secretary, Mr. M. K. Vellodi, in connection with the purchase of defence equipment, and the presence of the Defence Minister, Mr. Mahavir Tyagi, at the Farnborough Show, it is likely that the state-owned Hindustan Aircraft factory at Bangalore will embark on the manufacture of jet aircraft under licence. The Gnat has been named as the most likely product; and Folland Aircraft, Ltd., confirm that discussions have taken place.

Improved Turbine Fuel

AVIATION turbine fuel for commercial transport aircraft conforms to M.o.S. specification D.Eng.R.D. 2482. Hitherto, this has laid down a freezing point of not greater than – 40 deg C,

but it has been appreciated that any depression of this figure would be a considerable advantage, particularly in the operation of advanced types of high-flying aircraft.

Shell Petroleum now announce the development of a fuel which, while conforming to D.Eng.R.D. 2482 in all other respects, can be employed in ambient temperatures down to as low as – 50 deg C. An extensive refinery programme has been initiated, and plans are in hand to ensure that the new fuel (which is still known by the original specification) will be available on a global basis by the spring of next year. The first aircraft to use the fuel will be the Bristol Britannias of B.O.A.C.

Duff Gen Department

WE have on our desk a release from the British Information Services, a British Government agency; a release circulated to all the principal magazines and newspapers in the U.S.A. The heading is "British Engine in World Speed Record," and it goes on to point out that the recent 822 m.p.h. mark set by a North American F-100C "is affording considerable satisfaction to British aircraft manufacturers." It goes on "they are cheerfully reminding each other that the F-100C's engine is the British Sapphire . . ." Not content with this, the report continues by stating that the Bristol Olympus "developed to produce 15,000 lb thrust, is being made by Pratt and Whitney" (it is not, and will not be); further news is that "equipped with an after-burner [*sic*], *also a British device* [our italics], it can produce as much as 25,000 lb thrust."

All this "information," of course, is provided at the expense of the British taxpayer, and is supposed to carry with it the authority of the British Government.

FROM ALL QUARTERS . . .

New Folland Directors

IT is announced that Mr. Christopher E. Blunt and Mr. John A. Grace have been elected to the board of directors of Folland Aircraft, Ltd., makers of the Gnat light fighter. Mr. Blunt is a director of a number of companies, including Philip Hill, Higginson and Co., Ltd. Mr. Grace joined Follands as its commercial manager early this year.

Vickers-Armstrongs Special Directorships

THE appointment of three new special directors was announced last week by Vickers-Armstrongs (Aircraft), Ltd. The three are: Mr. G. R. Bryce, chief test pilot of the company; Mr. A. Greenwood, assistant general manager (service); and Maj. P. L. Teed, deputy chief of aeronautical research and development.

"Jock" Bryce, who is 34 years of age, was commissioned in the R.A.F. in 1939, shortly after leaving Glasgow High School. He joined Vickers-Armstrongs in 1946 and was appointed chief test pilot at Weybridge in 1951. His Service career included duty in Fighter, Coastal and Transport Commands during the war, and he was later a pilot in the King's Flight.

Mr. Bryce, who has flown 45 types of aircraft and has over 5,000 hours in his log-book, flew with the late Capt. "Mutt" Summers on the first flight of the prototype Valiant, and has been in charge of all the main development work on this aircraft and on the Viscount.

Allen Greenwood, who is 38, was educated at Cheltenham and the College of Aeronautical Engineering. In addition to his post with the parent company he is an executive vice-president of Vickers-Armstrongs Incorporated, the American subsidiary. He joined the experimental department of Vickers-Armstrongs at Weybridge in 1939, and was flight test engineer on prototype aircraft, including the pressurized Wellington Mks V and VI. He joined the Fleet Air Arm and served until 1946, during which time his appointments included posts in the Admiralty Delegation, Washington, and the Department of Aircraft Maintenance and Repair. He further served as a pilot in 1832 (R.N.V.R.) Air Squadron until 1950.

Mr. Greenwood re-joined Vickers-Armstrongs in 1946 and later became personal technical assistant to the chief designer at Weybridge, who was then Mr. George Edwards. In 1953 he was appointed Service Manager (Weybridge) and took over his present post in 1954. He is responsible for the after-sales service of all Vickers aircraft, civil and military.

Maj. Philip Teed, who was educated at Dulwich, the Imperial College of Science, and the Inns of Court (he is a barrister), is deputy chief of aeronautical research and development, Vickers-Armstrongs—the department of which Dr. Barnes Wallis is the head.

Maj. Teed joined the organization as long ago as 1924, after previously serving in the R.N.A.S. and the R.A.F. He is an expert on the chemistry and physics of materials and is the author of a number of publications on the subject. This year he delivered the Royal Society of Arts Cantor Lecture on *The Fatigue of Metals*. He is a council member and vice-president of the Institute of Metals.

Messrs. Bryce and (below, left and right) Greenwood and Teed.

CENTRE OF INTEREST: Mr. Stanley Hiller, Jr., and his vice-president, Mr. A. J. McK. Chadwick, discuss a rotor head with Raoul Hafner (Bristol helicopter chief designer) during a visit which the youthful American manufacturer—he is 31 years old—paid recently to the Bristol works. On the right is Mr. Colin Cooper, of Helicopter Sales, Ltd.

Hunting Expedition

THE remaining preparations are now being completed for Hunting Aerosurveys' expedition to Grahamland. An aerial survey of this peninsula on the Antarctic continent has been ordered by the Government on behalf of the Falkland Islands Dependencies in which Grahamland lies.

The expedition's ship, the 900-ton *Oluf Sven*, is scheduled to leave London in mid-October, carrying the main party. She has been at a yard on Tyneside, where the necessary modifications have been carried out, including the fitting of a helicopter landing deck and extra accommodation. Meanwhile, individual members of the party have been doing special training here and in Canada, whence the two Canso amphibians will leave in November to meet the ship at the Deception Island base.

One of the most interesting jobs in the expedition will be undertaken by a team of four surveyors responsible for fixing the ground control for the aerial photography—an essential preliminary to the mapping subsequently to be done.

One of the chief problems which they have to face are the ice cliffs which bar the way to the interior. The main function of the expedition's Westland Dragonfly helicopter will be to carry the surveying parties, in groups of two, to their positions. These points will mainly be decided by astro fixes. In view of the short hours of darkness of the Antarctic summer, this will entail several nights away from the ship, and the Dragonfly will therefore drop the surveyors late in the evening and pick them up perhaps two or three days later, on receipt of a message sent on their V.H.F. portable sets.

Mr. Edmund Sayers

WE learn with regret of the death, on September 20th, of Mr. Edmund Sayers who, until he retired in January, 1953, was manager of the B.T.H. aero equipment sales department. He had completed 48 years' service with the company.

In his early days with B.T.H. he had been concerned with sales of meters and other instruments. When, at the outbreak of the 1914-18 war, it was decided to concentrate the resources of the Coventry factory on the manufacture of high-tension magnetos for aircraft, Mr. Sayers was called on to take a share in the work, both in the sales department at Coventry and in the development laboratory, where he assisted with new magneto designs. After the war he was primarily concerned with sales of both aircraft and car equipment.

In the aircraft industry Mr. Sayers was particularly well known, being held in high esteem for his soundness of judgment and knowledge of aircraft electrical equipment. He was selected to represent aircraft accessory manufacturers when, at the invitation of the American industry, a party of British aircraft executives visited establishments in the U.S.A. and Canada in 1951. He was a council-member of the S.B.A.C., a member of its sales and export committee, and deputy chairman of its accessories committee. He was a Freeman of the City of London, and a Liveryman of the Worshipful Company of Coachmakers and Coach Harness Makers. Mr. Sayers leaves a widow and a son.

Godfrey-Fairchild

AN agreement has been announced between Sir George Godfrey and Partners, Ltd., of Hanworth, Middlesex, and the Stratos Division (Long Island, N.Y.) of the Fairchild Engine and Airplane Corporation; both companies are well known as designers and manufacturers of aircraft pressurizing and air conditioning equipment. The agreement, it is stated, provides for the exchange of ideas and techniques as well as making available to British and American aviation the products of both organizations.

COACH-AIR

—*on the London-Paris Route ;*

Skyways' Low-fare Service

TODAY, September 30th, Skyways, Ltd., are due to begin scheduled air services between Lympne and Beauvais, with coach connections at each air terminal providing through service between the city centres of London and Paris. The opening of services on the initial, winter frequency of one round trip daily was preceded, on September 21st, by two "inaugural flights" carrying some 50 Ministry and company officials, journalists and other observers.

Passengers (who included Sir Alfred Le Maitre, controller of Ground Services, M.T.C.A., Sir Wavell Wakefield, chairman of Skyways, and two of his co-directors—Mr. Eric Rylands, managing director, and Mr. C. F. Dickson) travelled from London to Lympne in East Kent luxury coaches. At Lympne, they boarded two 34-seat Skyways DC-3s, which flew in formation for part of the journey to Beauvais. The departure from Lympne marked its re-opening as a commercial airport, an event discussed on page 566 of this issue. The party was entertained on arrival by the Beauvais Chamber of Commerce, whose president, M. Communeau, was largely responsible for bringing Beauvais-Tillé to its new status as an international airport. In his speech, M. Communeau described the many obstacles to be overcome—at various levels—in the attainment of this aim, and he paid tribute to Mr. H. C. L. Leech, who, as Skyways' sales planning manager, handled the negotiations leading up to the start of the service. It was in June, after a discussion with Mr. Leech and M. de Lamaze, the airport commandant, said M. Communeau (according to the official translation of his speech), that "My imagination rose and I saw Beauvais becoming the French abutment of an aerial pier of cheap transports destined to a special class of tourists with moderate means but very numerous."

And so it may well prove, for the coach-air service is certainly calculated to appeal to the traveller to whom cost is a more important consideration than speed. The total London - Paris fare is less than by any other means of transport, including third-class rail and boat *via* Newhaven and Dieppe. Some comparative London - Paris fares (including incidental charges) and times (city-centre to city-centre) are given below.

	Fare			Time	
	£	s	d	hr	min
Air (tourist return)	15	9	3	3	50
*Rail/sea (2nd class return)	12	0	0	7	10
Coach/air (standard return)	8	15	0	6	50

The "standard" coach-air fare referred to above applies to journeys made on Fridays, Saturdays and Sundays. On other days passengers are charged the off-peak return fare of £7 14s. At present, separate tickets are issued for the London - Lympne section of the journey; eventually, however, combined tickets will be issued, resulting in simpler and cheaper booking procedures. If a passenger so desires, either or both of the coach journeys can be omitted from his itinerary, and the appropriate discount will be allowed on the price of his ticket.

City terminals for the service are the London Coastal Coaches office at Victoria (opposite B.O.A.C.'s Airways Terminal) and the Moderne Palace Hotel, Paris; Skyways have bureaux in each terminal. Refreshments are available during flight, at Lympne, at Beauvais and at the city terminals. The outward daily winter service leaves Victoria at 8.45 a.m. daily, reaching Paris at 3.35 p.m. (4.35 p.m. local time after October 2nd). Return services leave Paris at 11.25 a.m. (later 12.25 p.m.) and reach Victoria at 6.14 p.m.

Times, fares and distances for the three sections of the London - Paris journey are as shown at the foot of this page.

The schedule provides for transit times of 21 min and 30 min at Lympne and Beauvais respectively, bringing the total elapsed time for the journey to 6 hr 50 min. In this sense, therefore, the service is not competitive with the B.E.A. and Air France London - Paris services, though the difference in fares supports Skyways' belief that coach-air will attract a great deal of new traffic. The company now has approval to operate up to 21 return services daily, and frequencies can thus be increased as the traffic potential permits. A peak frequency of ten round trips daily is foreseen for next year's holiday season.

The critical factor in a combination service of this kind is, of course, the choice of sector distance for the air portion of the journey. In this case, the Lympne - Beauvais route was selected as giving the optimum combination of journey time and cost. The one-hour flight schedule, incidentally, is based on an airborne time (still-air) of 50 min.

At some time in the future Skyways' DC-3s are certain to be replaced, though the replacement has not yet been chosen. It is likely to be larger than the DC-3, and it will probably be fed by coaches of correspondingly greater capacity. Cost per seat-mile will, for obvious reasons, be a major consideration.

The coach-air principle is not, of course, completely new. It has not previously been applied, however, to a route between two major European capitals. The progress of Skyways' new service will be watched with keen interest—and interest will not be confined to air-transport circles.

* *Via* Dover and Calais.

Three stages of the service. (Above) East Kent coaches connect . . .

. . . at Lympne with Skyways DC-3s for the flight to Beauvais . . .

. . . where passengers board Paris-bound buses of Transports Renault.

Stage	Approx. distance (st. m.)	Carrier	Time hr min	Return fare standard £ s. d.	Return fare off-peak £ s. d.
London-Lympne	70	East Kent Road Car Co.	3 09	14 3	14 3
Lympne-Beauvais	123	Skyways	1 00	7 5 3	6 4 3
Beauvais-Paris	45	Transports Renault	1 50	15 6	15 6

HERE AND THERE

"New Spirit" Falls Short?

SO far, neither the Russian Press, nor radio, nor any of the Iron Curtain satellites have mentioned the Farnborough or Philadelphia air shows. Instead, prominence has been given to aviation days held in turn in all satellite countries to the east.

Two Bells

THE Uruguayan Navy has taken delivery of two Bell 47-G helicopters; they are to be used for training, rescue and general duties. The Uruguayan Air Force has been operating two 47-Gs for the past six months.

Model Velocity

A WORLD speed record for 5 c.c. control-line model aircraft was claimed for Britain last Sunday by Mr. Ray Gibbs, a competitor at the All-Britain Model Aircraft Rally held at Radlett Airfield. His machine achieved 146 m.p.h.

Picking up their Houses

A FAIRCHILD PACKET of the Italian Air Force visited Bovingdon Airfield last Tuesday to collect the first consignment of a £145,000 order for prefabricated barrack buildings. The contract, awarded to Maycrete, Ltd., of London, provides for the whole of the buildings to be collected by air.

Tanganyika's First Helicopter

A SIKORSKY S-55, carrying a mission sponsored by Sikorsky Aircraft and the Lederle Laboratories to study medical questions in Central Africa, landed at Kigoma on Lake Tanganyika on September 21st after a flight of 1 hr 50 min from Usumbura, in the Belgian Congo. It is believed to be the first helicopter seen in Tanganyika.

Campbell to try Again

THREE months after raising the water speed record to 202 m.p.h. in his Beryl-turbojet-engined hydroplane *Bluebird*, Mr. Donald Campbell is now planning to take the vessel to Lake Mead, near Las Vegas, Nevada, where he intends to make an attempt to raise the speed still higher. The present speed has been described as a critical one, introducing effects comparable in some ways with those of the sound barrier in air.

COMING TOPSIDE—in the deck-edge lift of U.S.S. "Ticonderoga" — is the McDonnell F3H-2N Demon, which recently completed carrier-qualification trials. This massive all-weather fighter is powered by an afterburning Allison J71, and can carry "the payload of an attack bomber" on its six stores pylons. It represents a very considerable advance on the original J40-powered XF3H of four years ago.

First Norwegian Helicopter

THE first Norwegian-built helicopter has been tested at Kjeller, Norway. Designed by Major Paul Kjolseth of the Norwegian Air Force, it is said to have a disposable load of 1,600 lb. Maj. Kjolseth claims that series production would reduce the cost to only £5,000.

Major Road Ahead

VICKERS-ARMSTRONGS' test pilot Peter Marsh had a narrow escape last week when a Canberra (an M.o.S. machine in use for special trials) in which he was landing at Wisley Airfield over-ran the runway and dived over its end, a steep drop of some 50ft, on to the main London-Portsmouth road. Any motorists in the vicinity must have had extra good reason to observe the recently erected warning notices at this spot—"Sudden Aircraft Noise."

No Plug Trouble?

THOSE of our readers who saw the first transmission by the Independent Television Authority, on Thursday of last week, may have noticed that the Hunting Percival Jet Provost has gained the distinction of being the first aircraft to appear on British "Commercial TV." The occasion was the newsreel report of the start of Jet Provost courses at Hullavington. A standard production T.1 machine was shown, flown from Luton by Dick Wheldon; air-to-air shots were obtained from a Proctor.

Air-mapping Persia

A BRITISH firm, the Air Survey Co., Ltd. (a Fairey subsidiary) has been awarded an aerial photography contract for the whole of Persia, in the face of competition from six other concerns. The contract may be worth £100,000 in the first year. Initially, the company will perform the whole of the work, but Persian staff will gradually be trained to operate their own cartographic establishment.

Dry-shod Sower

LAST August experiments were made in the sowing of 100 rain-flooded acres of farmland in the Wimmera district of Australia with seed scattered from light aircraft flying at between 50 and 60ft. One of the farmers concerned reported last week that 80 per cent of the seed sown on all but the worst of the area had germinated.

Davy Jones' Inland Locker

AUSTRIA RADIO recently devoted a special broadcast to attempts which are being made to raise the wreck of a German aircraft shot down in the Atter Lake near Linz in Upper Austria during the war. The machine, flown by an officer of high rank, was believed to have had on board large quantities of gold, precious metals, and currency, together with highly important documents relating to Hitler's last six days in the Berlin bunker. The wreck is lying at a depth of 240ft and up to the time of the broadcast divers had been able to recover only a few hand grenades.

HEAVIES DOWN UNDER: The two Valiants of No. 138 Sqn. which recently extended their Far East proving flight to include Australia are shown here on their visit to Sydney on September 13th. Their first public appearance there aroused considerable interest.

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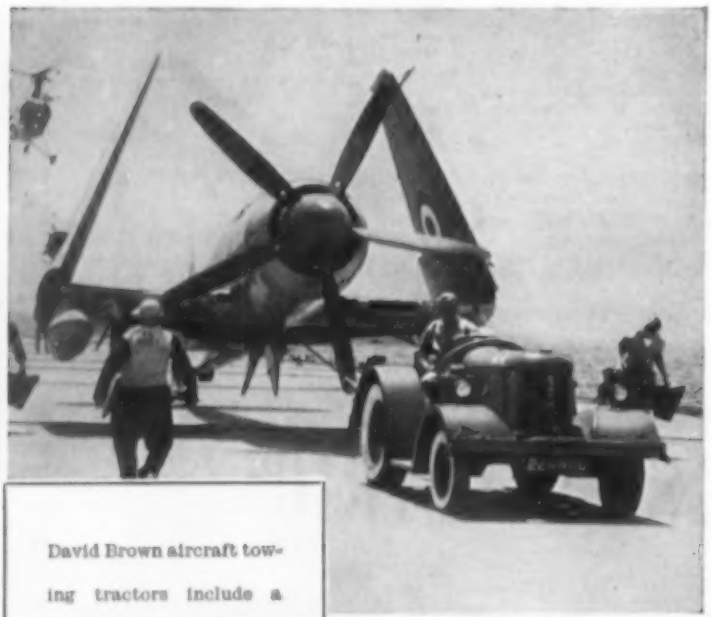

Flight deck of H.M.S. Warrior taken during exercises in the Japanese Inland Sea

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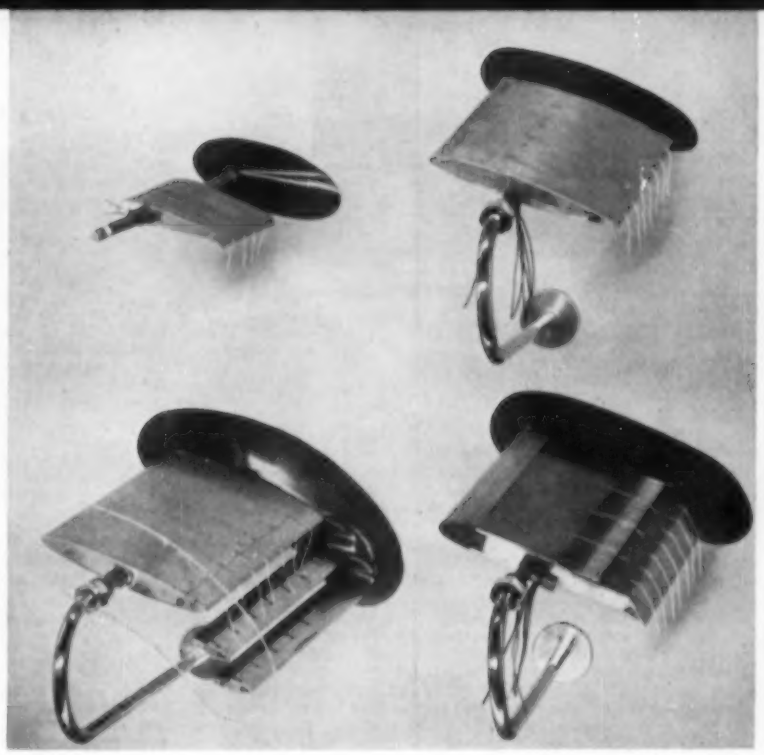
THE JET FLAP

A Fundamentally New Mechanism for Lift and Thrust

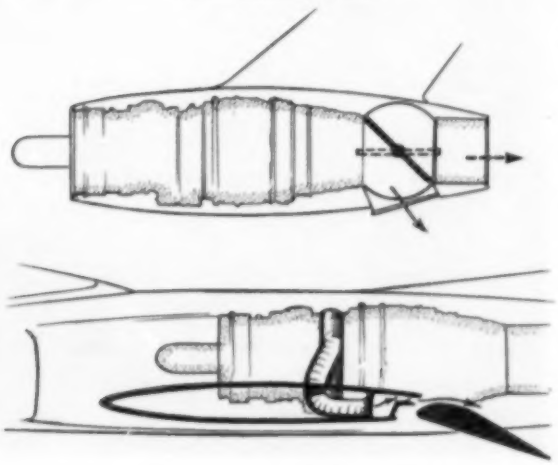


The first four tunnel models made by the N.G.T.E. Upper left, a simple 90-deg-downward model; upper right, high-velocity 37-deg model (the third); lower left, three forms of the second model, based on a 12½ per cent elliptical profile (varying jet angles); lower right, the thrust-boost model with multi-fishtail nozzles.

MANY have already commented on the fact that the gas turbine has made possible the realization of a long-sought-after aim in aeronautics: the integration of the powerplant with the airframe. It has long been appreciated that the present arrangement of fixed- and rotary-wing aircraft, in which lift is provided entirely by moving aerofoils, has no particular intrinsic merit, and that there may well be an optimum form of flying machine better than anything currently available.

The gas turbine has already been instrumental in the achievement of aircraft in which the powerplant itself contributes to lift. Probably the simplest arrangement is the straightforward downward-pointing turbojet, typified by the V.T.O. experiments of Rolls-Royce. A related system is the fixed-wing machine with jet deflection, of the type exemplified by the Westland/N.G.T.E. Meteor; here, however, what is blown down cannot provide forward thrust (speaking generally), so the system resolves itself into a powerful control of lift, particularly during the approach and landing. A third arrangement is flap blowing (sometimes referred to as supercirculation), in which air is bled from the compressor and ejected from a spanwise slot ahead of a conventional wing flap, in order to re-energize the boundary layer, prevent separation and greatly increase the maximum lift coefficient. Here again, however, the quantity of bleed air—which is far greater than anything previously attempted—robs the engine of a great deal of its forward thrust.

Two previous ideas which are not to be confused with the jet flap: upper, the jet-deflection system tested on a Meteor (the valve box is purely diagrammatic); lower, flap-blowing or supercirculation, used on the Supermarine 525.



The National Gas Turbine Establishment are now pursuing a line of development which is fundamentally new; they describe it as "a new dynamic principle which is nowhere to be found in nature." It has been named the "jet flap," although this suggests the use of a mechanical flap.

Basically the idea is that all the gas turbine effluent—whether from a turbojet or turboprop—is discharged as a thin sheet from a spanwise slot along the rear of the wing. In cruising flight this jet would issue substantially horizontally so that, except for the unconventional shape of the jet orifice, the aircraft would behave much like present fixed-wing machines. At low air-speeds, however, the jet would be inclined downwards and, as will presently be described, could develop truly formidable lift. Nevertheless, it should be made clear that the jet flap is not intended to confer V.T.O. or hovering ability. On the other hand, it has an exceedingly powerful effect at even moderate forward speeds.

As an introduction we may quote from a statement provided by the Ministry of Supply (of which the N.G.T.E. is one of the chief research establishments), outlining the aerodynamic background of the development: "As is well known, the lift on an aerofoil is most conveniently estimated not from the true equations of motion, but from the equations for a perfect fluid plus some external assumption. Although it is the criterion which determines the circulation around the profile, that assumption is not always the same. For example, with a rotating circular cylinder it would be the speed of rotation, whilst for a conventional aerofoil it is the well-known Kutta-Joukowski hypothesis.

"The essence of the jet flap is that it is a system to which the Kutta-Joukowski hypothesis does not apply, the upper and lower mainstreams behind the aerofoil being divided by the jet which extends in theory to infinity. In theory, the jet is therefore replaced by a momentum flux line across which the pressure difference in the mainstream is such as to balance the centrifugal force of the real jet fluid. Thus, the path of the jet is given by the solution of an integral equation and, once this has been obtained, the lift distribution on the aerofoil follows from the usual equations of motion.

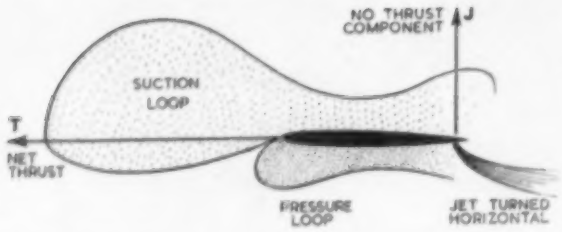
"As a result, the same jet thrust will produce the effect of only a small flap at high flight speeds, but that of a large Fowler flap under take-off and landing conditions, the significant parameter being the jet co-efficient, which is defined by

$$C_J = \frac{\text{gross jet thrust}}{\text{dynamic pressure} \times \text{wing area}}$$

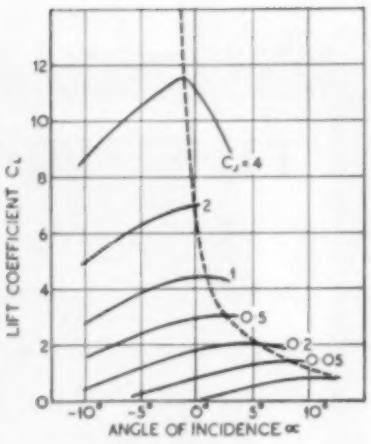
Very roughly, the effect is that which would be produced by a Fowler flap with the same angle of deflection as the jet flap, but having a chordal extension of 0.4 C_J.

"Those are the effects in a perfect fluid system, but in practice much depends upon the jet mixing process. So far as the lift is concerned this is highly beneficial, for it gives rise to a major entrainment or sink effect, which can in some circumstances suppress the stall. The thrust-drag story is more complicated.

"In the theoretical model, in which the jet is replaced by a



(Left) mechanism by which thrust is produced by a jet issuing vertically downwards from the trailing edge.



Variation of lift coefficient with angle of incidence (angle of attack), i.e. $dC_L/d\alpha$. Jet angle in this case was 58.1 deg. Maximum lift occurs at zero angle of attack, so that an aircraft with such a wing would always fly in a level attitude.

THE JET FLAP . . .

momentum flux line and the flow is everywhere potential, the paradox of d'Alembert must apply, and this gives rise to the problem that *in an idealized two-dimensional jet flap system the gross thrust is equal to the total jet reaction and independent of the angle of deflection of the jet.*

"On account of the jet mixing process this identity cannot hold exactly in practice, there being for this two quite different reasons. Firstly, at large values of the thrust coefficient the mixing process will involve a momentum loss which must appear as a loss of thrust. Secondly, since the mixing occurs generally in a region of varying pressure the system may function as an introverted thrust augmentor, so that the total thrust can in theory be either greater or less than the jet reaction.

"Usually the losses exceed the gains, but experiments have been made in which the total thrust was greater than the total reaction. In such circumstances the excess thrust appears, of course, as a form, or pressure, thrust."

Work at the N.G.T.E. began in November 1952, but previous research along these lines dates back at least to 1938. In this year the German aerodynamicists Hagedorn and Ruden were working in Hanover on boundary-layer control, in the course of which the effect of large quantities of ejected air at the trailing edge of the wing became apparent. They published a report, but this did not become available in Britain until after 1945. Similar work is also known to be going on at the O.N.E.R.A. in France, two of the principals in this programme being M. Jousserandot and his chief M. Poisson-Quinton.

During their work on jet deflection for the experimental Meteor the N.G.T.E. decided to attempt to discover a more efficient method of increasing lift by deflecting the jet. The jet flap really stems from this.

The first model made was a simple aerofoil of brass sheet bent around a tube and soldered. Air was blown from a downward-facing slit along the trailing edge, and the results proved the increase in lift but failed to show any induced thrust. Accordingly, a better induced-thrust model was made, capable of showing accurate lift and pitching moments for comparison with the theory from the first model.

In potential-flow (no-loss) theory, forward thrust is not a function of jet angle. With the jet ejected at 90 deg, i.e., vertically, the N.G.T.E. measured about 30 per cent of forward thrust; this was, however, a crude model, and considerably better results are possible. Later it is expected that it should be possible to recover half the theoretical form thrust $(1-\cos\theta)$, so that at 60 deg to the horizontal 75 per cent of the true thrust should be possible. A wing equipped with the jet flap has three main derivatives:

$$\frac{dC_L}{d\alpha}, \quad \frac{dC_L}{d\theta} \text{ and } \frac{dC_L}{dC_J}.$$

J is the jet reaction or momentum of fluid issuing at the spanwise nozzle (or, alternatively, the total reaction on the engine bearers).

The thrust is then approximately $J\cos\theta + \frac{1}{2}J(1-\cos\theta)$. This is an empirical formula, scarcely better than a hunch, but inaccuracies are not thought to be important in practice since smaller deflection angles would be employed. At very high lift conditions the jet acts as a physical entity which is very powerful in comparison with the main stream. It operates at low speeds to entrain a considerable air flow and, even if separation occurs above the wing, re-entrainment continues due to sink effect.

Research then continued with a truly elliptical wing section of 12½ per cent thickness, this having a sufficiently "beefy" trailing edge in order to insert a spanwise plenum chamber and ejection slit. An approximate area ratio of 40:1 was chosen between the plenum chamber flow and the flow through the slit. Maldistribution of gas would naturally give bad spanwise distribution of lift and induced drag. The experiments were nominally two-dimensional, but it was possible to achieve induced drag, the circulation falling off in the tunnel boundary layer.

On the second model, the chordwise slot measurement was 0.018in and deflection angle was originally 90 deg, for the assessment of pressure and induced thrust. The maximum induced thrust was found to be 37 per cent, at which point leading-edge separation occurred.

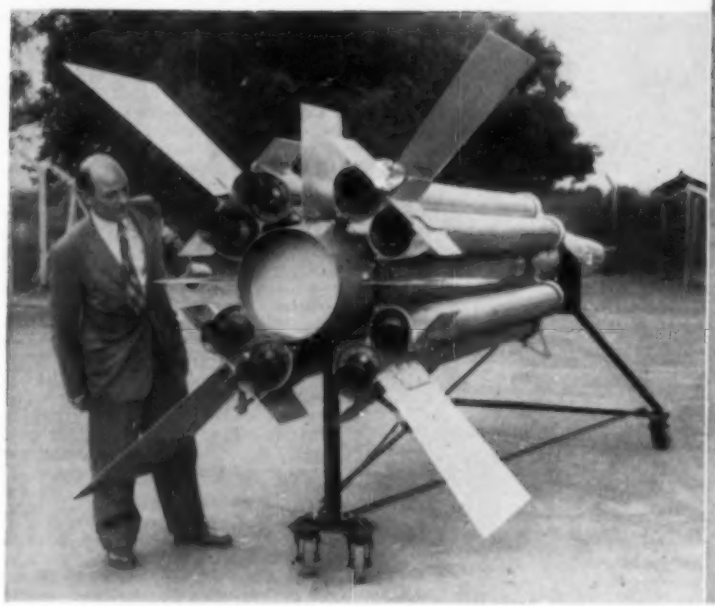
One of the main aerodynamic effects which was experienced on the first series of tests was the sink or entrainment effect due to the mixing process, this being found to operate even at $\theta = 0$ deg. Provision for cruising flight will have to be made, and it is clearly impracticable to have two jet exits. Accordingly, a third model (a thrust/drag model) was made. With this model, considerable mixing effect and noticeable variations in static-pressure distribution were discovered around the wing, but it was demonstrated that these could be removed in cruising flight. A fourth model (a thrust-boost model) was then made to see if it were possible to obtain increased thrust augmentation. Here the jet was split into multiple fishtails, but the experiment failed owing to induced drag and other effects.

An accompanying diagram shows the mechanism by which the thrust is produced. The fact that, in forward flight, the jet is turned horizontally implies that there must be a thrust reaction on the wing. Thrust is provided by the strong curvature of the flow forwards along the under-side of the leading-edge and back across the top of the wing. The main airstream is diverted upwards upstream of the leading edge, and the centre of the total lift is somewhere near 50 per cent chord.

With a suitably designed wing the local flow should be unstallable up to a lift coefficient of at least 10. Applied to an actual aircraft some compromise would be essential and a rather different wing profile would have to be adopted. Nevertheless, the term $dC_L/d\alpha$ would not become negative until considerably after the onset of separation, owing to the jet impingement effect. Equally, the onset of instability would only occur at very high lift coefficients. Aircraft control would be primarily a function of jet thrust, the tailplane being relegated to the rôle of a stabilizing member. Thus, the pilot might not be able to put the aircraft into a stalling attitude.

(concluded on page 558)

The almost incredible distribution around a 12½ per cent elliptical wing with jet at 58.1 deg to the horizontal. Tunnel velocity was 30ft/sec and Reynolds number about half-a-million. Lift coefficient in the photograph was about 12, or almost double the limit (of 2π) set by the Kutta-Joukowski hypothesis. With the jet flap, maximum lift coefficient is infinity. Note: the experiment was actually run the other way up.



Two views of RJTV 27, the obviously unused ramjet test-vehicle which was publicly exhibited at the N.G.T.E. last week. Many transmitting aerials (whip aerials) projected from its silver skin. Curiously, the vehicle has no ventral fin, no doubt to ease launching problems.

RJTV 27

A British Ramjet Development Revealed

SO far, very little has been revealed regarding British work in the field of ramjets. In fact, the only tangible evidence of progress was the static display (at the S.B.A.C. exhibition of 1952) by the Bristol Aeroplane Company of a twin-ramjet, rocket-boosted test vehicle, which we illustrated and discussed at that time.

Last week, the Ministry of Supply permitted a visit to the National Gas Turbine Establishment at Pyestock (South Farnborough), Hants. Notwithstanding its title, this establishment is also considerably concerned with ramjets.

As far as non-helicopter applications are concerned, the ramjet is a supersonic engine. Compression of the intake air is effected by the conversion of energy from kinetic to pressure; and this process is largely governed by the shock-wave pattern at the intake. Simplest of all intakes is the direct pitot (a simple hole) but the normal shock produced by such a system causes severe losses in efficiency at high supersonic Mach numbers. Much better pressure recovery can be had from the family of inclined shocks arising from a spiked centre-body. At Mach 1 a pressure ratio of about 1.8:1 can be obtained, but this improves to no less than 36:1 at Mach 3 (say, 2,000 m.p.h. at high altitude).

Fuel is injected aft of a diffuser section, and the resulting jet of hot gas (it is virtually a continuous flame) escapes from the propelling nozzle at the rear. The only rotating component needed is the fuel pump, and this can readily be driven by a ram-air turbine. An obvious penalty of a ramjet vehicle is, of course, that it is not self-sustaining until it has reached a quite considerable flight speed (about $M = 1.5$ for a $M = 2$ vehicle).

Another difficulty in ramjet testing is the scale of test equipment needed. By its nature, a ramjet has either to be pushed through the air very quickly (much faster than any present British aircraft) or else have to have a simulated supersonic airflow fed into it. In practice both methods are used, the ground running being used up to the limits of its capability—which are usually far short of the design speeds and altitudes. Ground rig-testing is, however, a pre-requisite to any free-flight trials.

At the N.G.T.E., combustion chambers for ramjets are bolted direct on to the end of the plant air-supply. The latter is fed in at from 40 to 50 lb/sq in absolute (corresponding to supersonic flight at fairly low altitude) thus imposing mechanical loading comparable with those of the worst flight conditions. In addition, powerful hydraulic jacks are used to move the air valves in order to reproduce the violent build-up of both airflow and pressure experienced during a rocket-boosted take-off of a test vehicle.

To test the combustion at high altitude (where problems are usually worse) it is necessary to employ a continuously exhausted chamber where ambient pressure is considerably below atmospheric. At the N.G.T.E. a relatively small chamber was shown, in which models could be tested at up to $M = 2$ at 40,000ft equivalent altitude and at angles of attack (or yaw) of up to 15 deg. Shock formation could be recorded by means of spark photography.

Ultimately, of course, there is no substitute for full-scale free-flight trials. The principal method of conducting such trials has been to build the ramjet into a simple fuselage, complete with stabilizing fins, and launch it by booster rockets capable of imparting so high an acceleration that the ramjet reaches its critical light-up (self-sustaining) speed before the boosters burn out. One such test vehicle was actually on view, and is illustrated here.

It was designated RJTV 27 (ramjet test vehicle), and had been built by D. Napier and Son, Ltd. At a rough guess the length and diameter must be about 16ft and 20in, respectively, and the weight (less boosters) about 1,000 lb. No information regarding this fearsome vehicle was forthcoming, but it is unlikely to have been designed for a Mach number higher than about 1.5, owing to its use of a plain pitot intake.

This intake is bifurcated into upper and lower ducts, and it is believed that fuel is contained in a flat tank between the upper and lower airflows. Above and below the centre section could be seen small intakes (visible in the photograph) which admit ram air to the fuel pump; the corresponding exhaust is on the port side. At the forward end could be seen transmitting aerials for the information required by the ground station, one unit on each side of the fore-body being a curious Perspex prism mounted over a piece of embossed foil—presumably a transponder for radar tracking. Doppler speed transmission is probable.

There are eight boosters, each pair carrying a massive fin and joined together at the front by a small wing (set at about 20 deg) used to pull the boosters away at the separation point. All fins are of trapezoidal section.

Altogether, it was instructive and heartening to see RJTV 27, particularly as it is fair to assume that it must now be outmoded by much later vehicles. Most such test-vehicles are, of course, completely expendable, although it is likely that a great deal of useful information can result from examination of the wreckage.

The upper machine is the final production form of McDonnell F-101A Voodoo strategic fighter. This one has two tanks on, but an atomic weapon can be carried on the centre pylon. Limiting speed is M=1.5. The Douglas A4D-1 Skyhawk is now completing carrier qualification trials. The machine used is shown about to arrive on board U.S.S. "Ticonderoga," trials carrier.

AIRCRAFT INTELLIGENCE

U.S.A.

Boeing KC-135. Subject of a large order for the U.S.A.F. Strategic Air Command, this four-jet tanker/transport will weigh at least 200,000 lb and may be powered by Pratt and Whitney J75 turbojets, each of some 15,000 lb thrust. Only one powerplant will be fitted with a full starting system: the other three will be turned over by air bled from the engine already running. It is not stated whether this bleed-air will drive geared-down air-turbine motors or will form a jet acting directly on the main engine turbine.

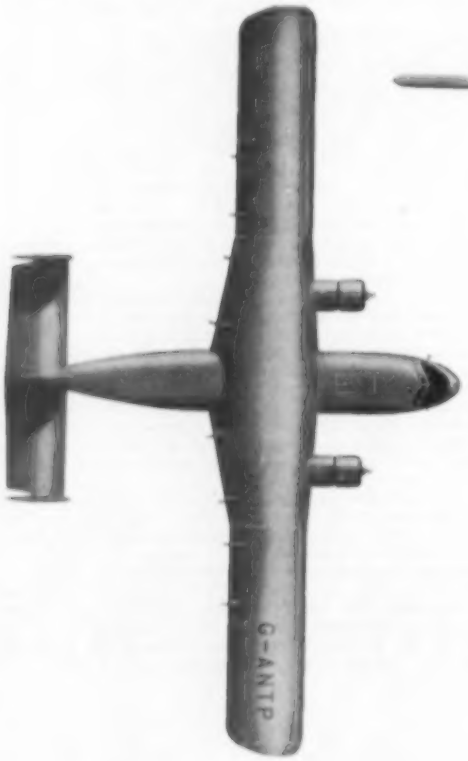
Convair YC-131C. Corresponding roughly to the civil CV-340, there are two of the turboprop test beds, each powered by a pair of Allison YT56s installed in a manner rather like that specified for the Lockheed Electra. Operated by the 1,700th Air Transport Group (Kelly A.F.B., San Antonio, Tex.), the two machines have put up some impressive utilization figures: one that must surely be a world record is the fact that the two aircraft logged a combined total flying time of 46 hr 20 min (split evenly between the two) in a single recent period of 24 hr.

Martin B-57D Canberra. Unlike other production types of Martin B-57 this machine is powered by two Pratt and Whitney J57-P-5 split-compressor turbojets; previous B-57s have had Wright J65 Sapphires. Use of the J57 greatly increases the bulk of the nacelles (the engines project well ahead of the wing) and also the weight of the aircraft; on the other hand, performance—particularly altitude performance—is much improved. The maximum sea-level speed is given as 675 m.p.h. The B-57D is a high-level bomber, although photo-reconnaissance versions are no doubt also being built.

France

Leduc 022. Two prototypes of the first supersonic Leduc ramjet aircraft are now rapidly being built at the Argenteuil factory. The airframe has been broken down into a number of sub-assemblies so that work can go ahead faster on each part. Final erection will consist merely of putting completed portions together. The 022 main undercarriage will retract into the root of the thin swept wing and the nose gear will fold into the pointed nose. The slab tailplane has slight anhedral.

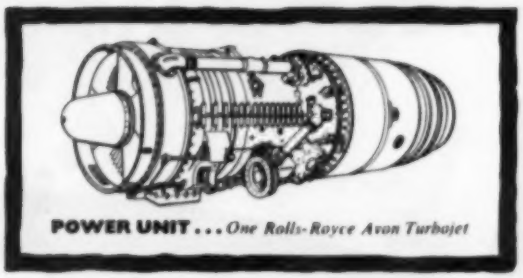
Nord 2501 Re-engined. The S.N.C.A.N. are at present re-engining a Nord 2501 Noratlas (twin-boom transport) with a pair of 2,450 h.p. Pratt and Whitney Double Wasp CB-17 engines. Use of these will increase maximum power by some 900 h.p. and should confer better performance and also permit a considerable increase in maximum weight. The new powerplant will be an alternative to the Hercules in civil Noratlases.



SCOTTISH AVIATION TWIN PIONEER
(Two 550/570 h.p. Alvis Leonides)

Span	76ft 6in
Length	45ft 3in

THE *FAIREY* DELTA 2



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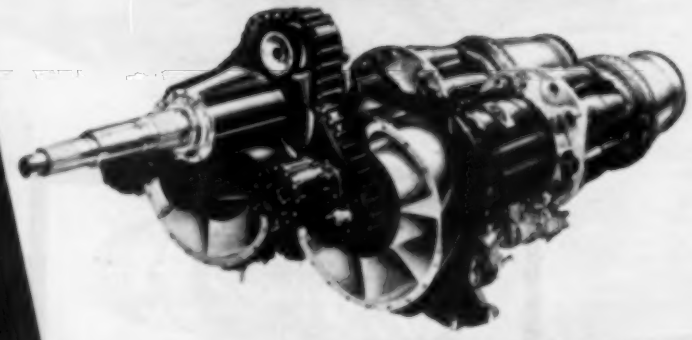

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THE AREA RULE

A Universally Applicable, Rule-of-thumb Law for Transonic Design

By THE TECHNICAL EDITOR

Richard T. Whitcomb, at present head of the 8ft transonic tunnels section of the N.A.C.A. Langley Laboratory. He led the team which evolved the area rule.

TO the American National Advisory Committee for Aeronautics goes the credit for the establishment of a law governing the design of transonic aircraft—a law which is of the utmost importance yet almost laughable in its simplicity. And, ironically, we in Britain came within a hairsbreadth of discovering it years before, only to conclude that such a line of development was of little practical value.

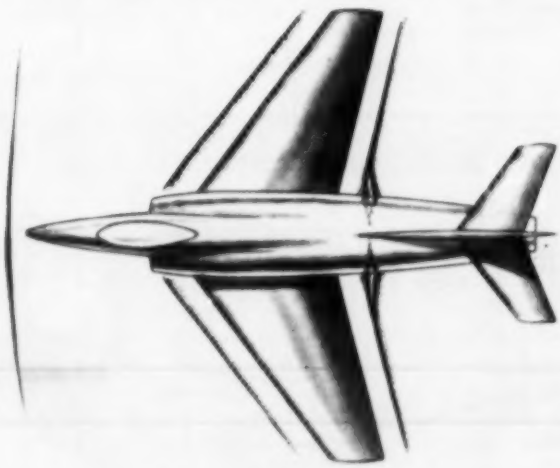
Before laying down the rule itself it is as well to give a rough outline of how it came to be evolved—and, also, to cast a clear distinction between area rule and the original indented-fuselage idea of the German aerodynamicist Kuchemann. During World War 2, the latter noted that the flow over a swept wing turned in towards the plane of symmetry (or fuselage, if one were present) and then spread out again as it passed the point of maximum thickness. He reasoned that the drag of a wing/body combination could be reduced by re-moulding the fuselage to follow the local streamlines, i.e. by waisting the body to the form which was later dubbed "Coke-bottle." As far as is known, Kuchemann's modification was of a purely local nature to suit the flow over a swept wing.

The area rule is far more versatile, and applies to any form of body (we use the word here in its widest sense) designed to pass through the transonic regime. As is now universally appreciated, such a body suffers a great increase in drag coefficient as the Mach number rises up to unity. For some 15 years designers have laboured to reduce the peak of this drag curve, and have sought various wings and wing/body forms which would give good results.

As far as wings are concerned, several solutions have been found to this problem of drag reduction (or, rather, of suppressing drag-rise). Sweeping the wing back is one answer, and another is reduction of thickness/chord ratio. But body forms have not hitherto produced any significant reduction in transonic drag, and have always tended to design themselves, as a result of having to meet a multitude of operational requirements.

Furthermore, when a complete design had been settled—on the basis of calculations which are now known to have been either uncertain or downright incorrect—there was no alternative to flight testing in prototype form. Admittedly, and bearing in mind the extent to which designers were working in the dark, serious trouble resulting in the loss of prototypes has been rare; but scarcely one design (the Sabre is an obvious exception) reached its maximum design performance without the expenditure of months or years of modification. Some never did.

Tunnel testing has naturally been of some help, but until 1951 (or until today in this country) has always fallen down completely in the vital range between Mach 0.9 and just over 1. Subsonic results have always been obtainable, and so have supersonic; but the critical transonic region has always been lost in a mass of choking and reflected shock-waves. What has always been desperately needed has been a *picture* of flow through the whole transonic regime. Even in full-scale flight testing such a picture has been hard to come by; in particular, nobody, so far as we know, has ever been able to photograph the flow over a complete aircraft at Mach 1.



Plan view of a non-area-rule aircraft at around Mach 1: the split-root normal shock can be seen behind the wing.

It is hardly surprising, therefore, that one manufacturer after another became "bogged down" (British terminology) or "snarled up" (American), and had to adopt a series of trial-and-error "fixes" to get clear. It is especially worth while singling out one factory, Convair San Diego, whose F-102 intercepter will always be the classic case of application of area rule to a "snarled-up" aircraft. The F-102 was intended to be supersonic, and Convair gave it the thinnest of delta wings and the most powerful afterburning engine available; but the prototypes became stuck fast at Mach 0.9, and there were ominous rumours that the U.S.A.F. would cancel the contract. We will describe what happened to the F-102 later.

As we have said, what was needed was a picture of transonic flow. Such pictures became available in 1951 with the advent of the transonic tunnel, capable of operation at all Mach numbers including the vital 0.9/1.1 range. Development of such a tunnel, with its ventilated throat and perforated interior to reduce shock reflection, is another of the N.A.C.A.'s achievements; the engineer principally responsible was John Stack, the assistant director of the Langley Aeronautical Laboratory.

Using the eight-foot transonic tunnel at the Langley Laboratory, a basic-research programme was established into transonic flow in 1951. The team assigned to the programme, headed by Richard T. Whitcomb, were not asked to deliver any particular results: instead, their terms of reference encompassed a study of the drag and shock formation over various simple wing/body forms. Our contemporary *Aviation Week*, which published the first full account of the area rule in the U.S.A., has also published Whitcomb's report.

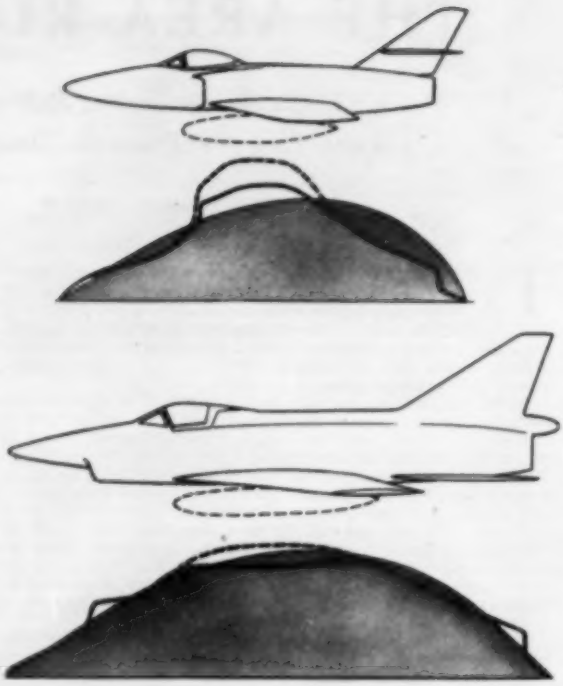
The first thing that really shook the N.A.C.A. team was the evaluation of schlieren photographs from the first series of tests. Using a conventional wing/body model at Mach 1, they saw a strong normal shock *behind* the trailing edge of the wing. The shock had a bifurcated (lambda) foot, and extended so far into the airstream that its area was very large in relation to the cross-section of the model. It was not unreasonable to infer that most, if not all, of the transonic drag-rise was caused by the energy-dissipation around the edges of this shock as it was towed through the air at the speed of sound.

It was already known that the body with minimum transonic drag was a body of revolution; theoretically optimum bodies can be derived mathematically, and N.A.C.A. Technical Note 3478 *On Boat-tail Bodies of Revolution Having Minimum Wave Drag*, by Keith C. Harder and Conrad Rennemann, Jr., gives a number of specific shapes. As soon as wings are added, interference drag sets in, until—at Mach 1—the interference drag can exceed the drag of the wing itself. At higher, supersonic, Mach numbers the interference drag becomes relatively less important.

Obviously, the N.A.C.A. team began to play with various forms of wing/body combinations, plotting the pressures and taking schlierens with the aid of the invaluable transonic tunnel. Whitcomb's men found that the total transonic drag of an aircraft was by no means the sum of the component drags; each bit

THE AREA RULE . . .

Bodies of revolution: upper, the minimum-drag shape (admittedly one of fairly low fineness ratio); lower, a modified body corresponding to a winged aircraft not designed to the area-rule formula.



(Right) The upper aircraft is a pre-area-rule design; under it is drawn a curve of total cross-sectional area plotted station by station, superimposed on a shaded area representing the minimum-drag area distribution. The lower machine is much nearer to the area rule, as shown by the correspondence of the area plot with the ideal form. The centre fuselage is pinched in so that an external store (broken line) will not cause too great a total cross-section (also in broken line).

affected all the rest. It was also found that even slight changes in fuselage profile could result in startling changes in total transonic drag. These slight variations in body-form had a profound effect upon the size and strength of the normal shock aft of the wing root, and hence in the total energy loss. Another discovery, logical enough in retrospect, was that the total drag of typical aircraft models at Mach 1 corresponded quite well with that from bodies of revolution modified (see sketch) by a swollen mid-section equal in frontal area to the cross-section of the wing normal to the airflow. The shock-formations were also essentially similar.

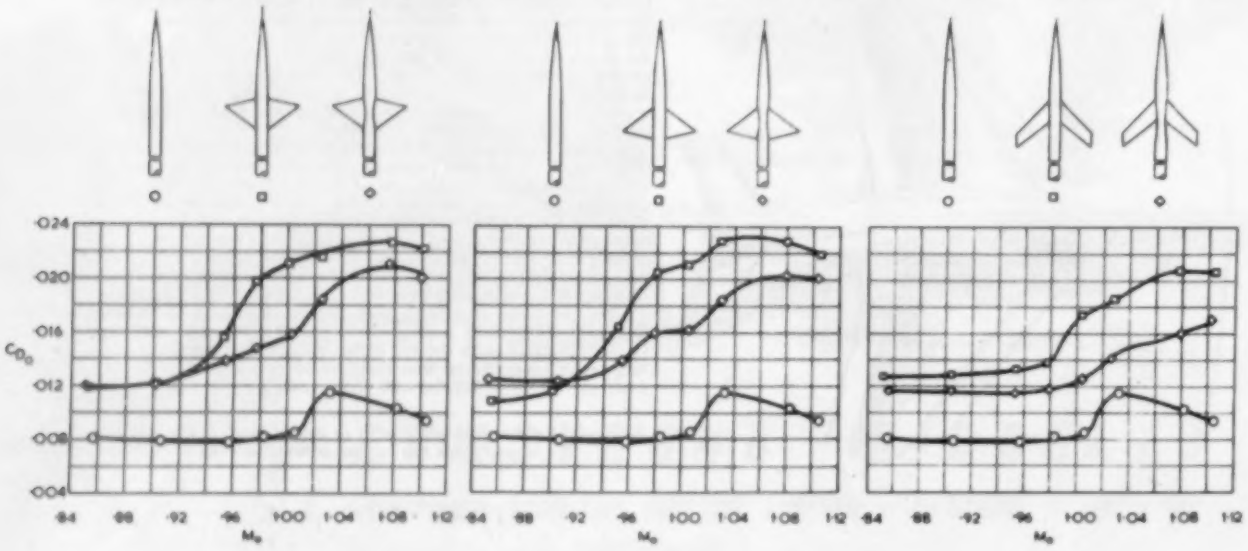
Whitcomb was then able to work things out on paper. He was confronted with the insistent fact that the transonic drag-rise consisted largely of interference drag. He had to find a way of reducing interference drag; if he could succeed in this, the total drag-rise would be not slightly reduced but virtually hewn away.

Others before him had tried to do precisely that. When he was at the University of Manchester, Prof. G. N. Ward (now of the College of Aeronautics) established a formula for the drag of slender bodies at supersonic speed, and deduced that such drag was a function only of the distribution of cross-sectional area. His formula was, however, invalid in the transonic regime: it was highly dubious at M = 1 and produced a discontinuity at lower speeds. Nevertheless, it was reliable enough to be a useful guide to supersonic design, and was definitely related to the area rule itself. Another ex-Manchester worker, W. T. Lord, evolved similar rules at the R.A.E. (where he still is), and an American, Wallace D. Hayes (then of North American Aviation, Inc.) also worked on the problem.

All these investigations were of a mathematical nature, and the British workers, at least, did not carry out any tunnel work; even if they had, they could not have covered the transonic region. Nevertheless, all were on the verge of the area rule and, to quote *Aviation Week*, "many clues could be found in their unclassified publications." The problem of security was, of course, a very real one to the N.A.C.A. and U.S. Government, for the area rule, once established, was as important a military secret as was the atomic bomb in World War 2. In the event, no direct reference to the N.A.C.A.'s work was published until two weeks ago.

What Whitcomb did was to consider stream tubes of a diameter greater than the wing span of his tunnel models. He explored the streamlines as they passed across the ogive-type nose, along the body—either of a cylindrical of a curved form—up over the wing (or, in a comparable body of revolution, over the annular bump) and away to their original paths downstream. The presence of the model naturally distorted the flow in any plane normal to the major axis of the model; but the distortion was smoothed by the pressure changes along the circumference of the stream tubes (caused by variation in local flow-velocity) and by the tendency of all streamlines to resist displacement.

Zero-lift drag coefficient plotted against Mach number for unswept triangular, delta and swept wings. These are actual tunnel results.



The area-ruled Convair F-102A. Compared with the subsonic XF-102, this machine has a greater fineness-ratio, pinched-in centre fuselage, increased cross-section at the tail, and other refinements.

He found, to quote from his own report,* that "the close similarity of the shock formations for the wing/body combination and the body of revolution with the same axial variation of cross-sectional area in most regions of the fields suggests that in these regions the energy losses associated with the shocks . . . should be nearly the same." Similarly, the relation between the shocks and the boundary layers were roughly similar. His report goes on to outline shock phenomena and drag characteristics for basic bodies, an unswept wing and cylindrical body, delta wing and cylindrical body, swept wing and cylindrical body and a swept wing and curved body. In each case his team used a model with one square foot of wing and took measurements at zero lift.

Some of the N.A.C.A. results, plotted as curves, are published here. Whitcomb considers them to be accurate within 0.0005 for values of absolute drag coefficient. Wall-reflected disturbances were responsible for the absence of results near $M = 1.05$.

Whitcomb compared the various sets of curves, and noted that adverse zero-lift interference drag-rise could generally be attributed to abnormally great rates of increase of cross-sectional area (of the entire aircraft, measured normal to the airstream). He wrote "these more rapid variations of area generally result in higher induced velocities and considerably stronger shocks. . . . Obviously, the interference drags associated with the increased shock losses are directly produced by changes in the pressures on the body and wing."

He then suggested that "it would be expected that indenting the body of a wing/body combination, so that the combination has the same axial distribution of cross-sectional area as the original body alone, would result in a large reduction or elimination of the drag-rise that is associated with the wing." This is the basis of the area rule; and, frankly, there is not much more to it as far as zero-lift drag-rise near to Mach 1 is concerned. But there is still plenty worth recounting.

It was early in 1952 that Whitcomb determined the area rule, and he presented his ideas to Langley's research department. He was given the go-ahead for experimental verification, and, by the time tunnel testing began in April of that year, he had evolved a corollary to the original area-equivalence theorem which said, in effect:—

If a wing/body combination (including, in a combat aircraft, external stores, and other paraphernalia) *be so designed that the axial distribution of cross-sectional area normal to the airflow is the same as that of a minimum-drag body then the design will have minimum drag.*

The method of applying the rule is simply to subtract cross-sectional area from wherever convenient (usually from the fuselage) to compensate for additions caused by such items as the wing or engine nacelles. Similarly, area could be added if necessary to bring slimmer parts up to the required cross-section.

This conjecture was completely justified by the experimental testing. The magnitude of the drag saving was enormous. For an unswept triangular wing at Mach 1 the ΔC_{D_0} was held at under 0.004, compared with over 0.009 previously; for a delta the figures were 0.0038/0.0103; and for a 45-deg swept wing 0.0008/0.0042. Full curves are reproduced here; better than any words, they show what area rule can do.

Further testing was carried out at the N.A.C.A.'s pilotless aircraft research station at Wallops Island, Va. Free-flight models were launched by booster rockets, and area rule was checked against similar aircraft models of conventional design. Basic data on the area rule were made available to the American industry—on a secret basis—in 1952.

We have already referred to the inability of the prototype Convair F-102s to surmount the Mach hurdle and establish itself as a supersonic intercepter fit for the U.S.A.F. A model similar to the XF-102 was tested in the 8ft tunnel at Langley, and it was confirmed that the drag hump rose to a value beyond the capability of the aircraft. Convair discussed the position with the Langley aerodynamicists, and decided that area rule was the only answer. In San Diego, the Convair engineers set about reshaping the design to conform to the new concept.

In October, 1952, the Grumman company visited Langley, and

* *N.A.C.A. Research Memorandum L52H108, "A Study of Zero-lift Drag Rise Characteristics of Wing-Body Combinations Near the Speed of Sound".*

(Left) These bulges on the Convair F-102A are hollow and were added solely in order to follow the area rule. Without them the machine remained subsonic. Incidentally, it was not the nipped-in waist which caused the F-102A to be likened to a certain film actress. (Right) First aircraft designed to the area rule from the outset was the Grumman F11F-1 Tiger, a supersonic carrier-based fighter. It was the first combat-type aircraft to exceed Mach 1 without using an afterburner.

THE AREA RULE . . .

the following February the Long Island firm had completed the layout for the Design 98, which has since materialized as the F11F Tiger naval fighter. This was the first aircraft designed to the area rule from the outset, and tunnel testing confirmed Grumman's hopes (and, to a large extent, the company's future): the Tiger was going to be supersonic. In October 1953, Convair also could sigh with relief: the revised F-102A was also going to be supersonic. Both companies started to build prototypes.

Grumman were the first to fly. A year after the completion of tunnel testing (i.e., in August last year) the prototype Tiger smoothly flew right through the transonic regime without even using its afterburner, implying less than half the Mach 1 drag of the original F-102. Later last year, the redesigned F-102A took off from Edwards A.F.B. and went supersonic while still in the climb.

Other aircraft are now using the area rule. One such is the new Chance Vought F8U Crusader, and here the application of the rule gave the Dallas engineers a very useful increment of volume around, and to the rear of, the powerplant. In this aircraft, the reduction in fuselage cross-section is not so marked as in the two other designs mentioned. Actually, it seems fair to put this down to the fact that the F8U is a more supersonic aircraft than the others, and area rule for inclined shocks comes out rather differently from the transonic application. So far, however, the N.A.C.A. have said nothing at all about supersonic area rule.

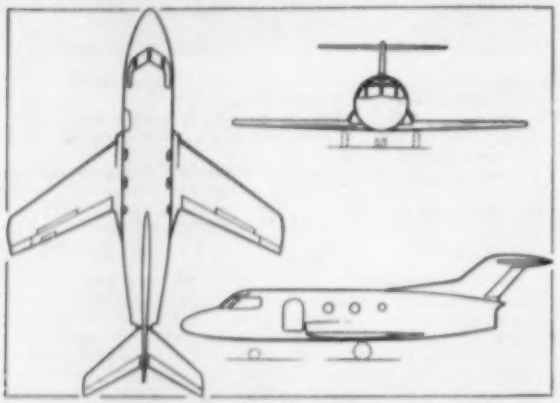
Nothing has been revealed about area rule for positive lift. In this case the lift vector is inclined back, but only at half the angle of the body so that the drag component of the lift is half what one might expect. Clearly, the area rule should be just as applicable at positive lift as for zero lift.

As a final note it may be reiterated that the rule depends upon total cross-sectional area, including tanks, rockets, gun packs or anything else which may project into the airstream. It is obviously a good procedure to nip the fuselage in a little bit more than is required by the wing alone, in order to have a little in hand for underwing stores. It might even be possible to have an aircraft with a variable cross-section in order to fly at the correct area distribution at all times. This might be done by having flexible skinning over the centre-fuselage, after the manner of some tunnel throats; more probable would be a portion—perhaps a piece of top-decking—which could be removed on sorties calling for externally attached stores.

AMERICAN EXECUTIVE JET TRANSPORT

THE Fairchild Engine and Airplane Corp., of Hagerstown, Maryland, have designed a "jet business transport" to cruise at 560 m.p.h. at 39,000ft with a crew of two and seven passengers on the power of four unspecified Fairchild turbojets of 1,000 lb thrust each (this figure suggests that they would be the company's J44s). The project is called the M-225.

Drawings show a low-wing monoplane with air intakes at the



wing-roots, and engines mounted behind the main passenger cabin. All four jet-pipes exhaust from the rear fuselage under the sharply raked fin and rudder. Both the performance and accommodation are the most advanced so far made public and correspond in many ways to that of the projected Martin B-57 command-transport variant. The fuselage is divided into three compartments, the foremost of which is the crew cabin. Immediately aft is a space containing galley, baggage and equipment compartments and W.C., all grouped round an entrance vestibule to which the main entry door with integral steps gives access at a point just forward of the engine air-intakes. There are three portholes each side of the cabin immediately aft of the vestibule, corresponding to the seating layout of two rows of rearward facing seats and one semi-circular bench round the rear bulkhead.

The undercarriage is tricycle and retracts inwards into the wing and forwards into the fuselage nose. No details of structure have been released, but dimensions are given as follows: span, 35ft 4in; length, 50ft 10in; height, 13ft 3in; wheelbase, 13ft 4in; undercarriage track, 8ft 8in. The sweep angle is 35 deg and empty weight is 8,870 lb. A useful load of 8,825 lb brings the gross weight up to 17,695 lb.

Fairchilds predict a "phenomenal" rate of climb of 5,160ft/min at sea level on four engines; loss of two successive engines would reduce this in turn to 2,290 ft/min and 1,020 ft/min. Cruising at 560 m.p.h. at 39,600ft the M-225 is stated to be designed for a range of 1,280 nautical miles.

The wing has almost parallel chord, with very short-span ailerons at the tips and flaps taking up the rest of the trailing edge. Air brakes are in the form of narrow spoilers rising from the wing surface immediately forward of the outboard section of the flaps. The take-off run is estimated to be 3,410ft and 5,720ft to clear a 50ft obstacle; the landing run would be 1,222ft over a 50ft barrier, with a ground run of 782ft.

In addition to designing the M-225, Fairchilds claim to hold Government contracts for research into the optimum configuration for a naval transport aircraft for short take-offs and landings, for a high-performance naval observation aircraft and for a utility liaison aircraft for the U.S.A.F.

ALUMINIUM INCREASE PLANNED

THE Norwegian Ministry of Industry is considering plans for increasing the output of aluminium at the State-owned plant at Ardal, West Norway, to 60,000 tons a year. Present production is about 24,000 tons a year.

The proposed increase will require a large development of hydro-electric power, and a total investment of between £15,000,000 and £20,000,000 would be necessary. Total Norwegian aluminium output is now about 70,000 tons a year.

GERMANY STARTS TO BUILD

FOR the first time in ten years, aircraft construction is to be initiated in Western Germany. The firm concerned is the well-known Dornier Company, who intend to go into production during the coming year with the Dornier 27, a high-wing light aircraft of high efficiency.

In the design of this aircraft Dornier have drawn upon the experience gained with the Dornier 25 prototype built in Spain and powered by a Tigre G-IVA of 150 h.p. (*Flight*, January 7th, 1955). It is expected that most production machines would have Continental or Lycoming units imported from the U.S.A. The production machine will have seats for five or six and a speed range from 160 m.p.h. down to as low as 30 m.p.h. Various civil and military uses are foreseen.

Production is to be undertaken at the company's works in the Neusubing suburb of Munich. Manufacture has not yet begun but is expected to be under way by the end of the year.

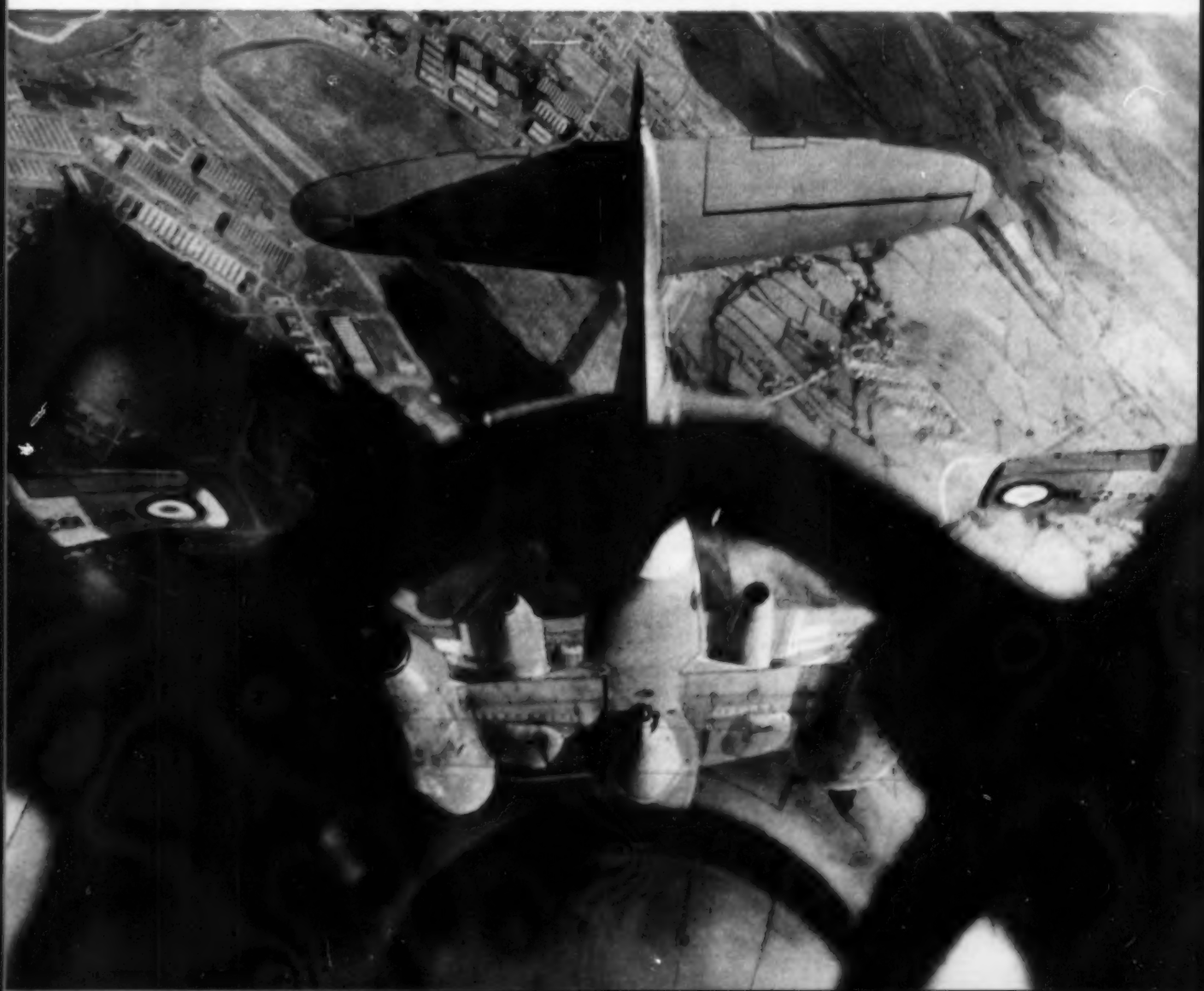
CANADIAN AFTERBURNING

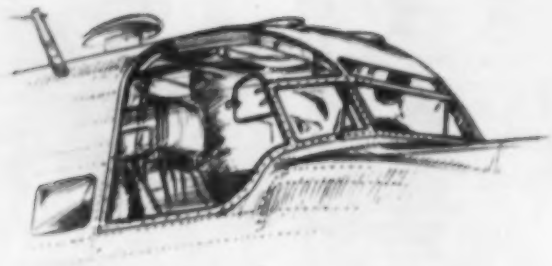
DURING the past four years, the National Aeronautical Establishment at Ottawa has been engaged in a research programme aimed at improving afterburning performance. The system under investigation differs from conventional reheat systems in that the afterburnt fuel is used to cool the turbine rotor blades, the temperature of the latter normally governing the maximum combustion temperature and hence the total power output. The Canadian system makes possible an increased rate of combustion within the engine itself, and thus produces a twofold gain in power.

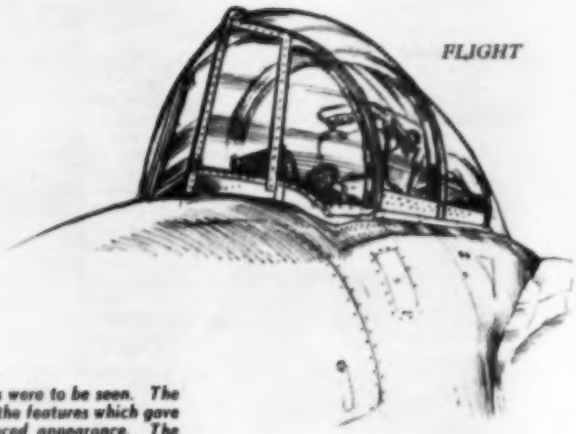
Flight-testing of this system has been in progress since the beginning of the year, using a Gloster Meteor F.4 (two Rolls-Royce Derwent) loaned by the British Ministry of Supply. During the first stage of testing, heights of over 40,000ft have been reached, and results are described as "quite satisfactory."

FORMATION FIVE

THE DRAMATIC picture below, secured by Gloster Aircraft photographer Russell Adams during a Battle of Britain display, conveys something of the actual feeling of close-formation aerobatics. The five Meteor T.7s were in arrowhead formation; Adams, riding in the tail-end aircraft, released his shutter just as they fell away from a wing-over. This quintet, from the Central Flying School, have perfected a tight-manœuvre "low-ceiling" technique that allows them to perform effectively in poor weather. Above are the team (left to right): F/L. M. Kemp, F/L. D. Franklin, F/L. T. Doe, F/L. D. Hall, F/L. H. Harrison (leader).





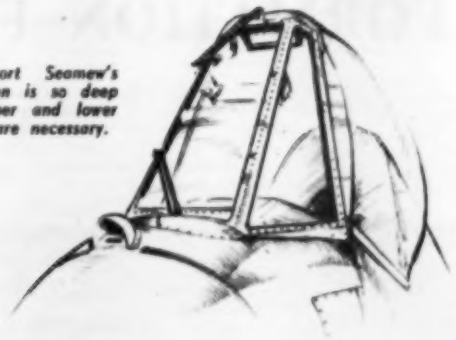


Several revised windscreens and canopies were to be seen. The new moulded canopy (above) was one of the features which gave the Shackleton M.R.3 its greatly enhanced appearance. The offset canopy of the D.H.110 (right) now has a sharply "vee'd" windscreen, the centre pillar of which is optically placed so as to be almost invisible to the pilot.

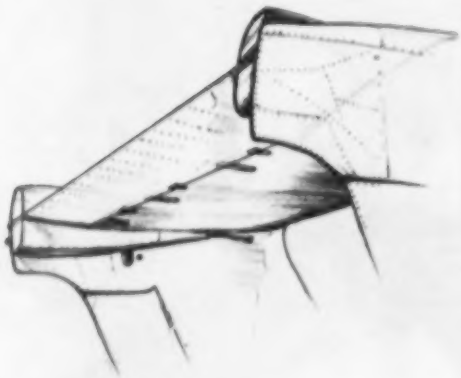
Artist's Postscript

—TO FARNBOROUGH: A TECHNICAL MISCELLANY

"Flight" Copyright Sketches and Photographs



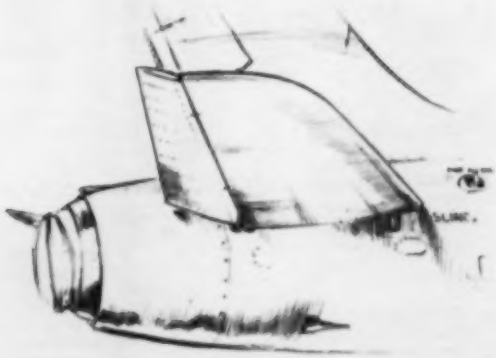
The Short Seamew's windscreen is so deep that upper and lower wipers are necessary.

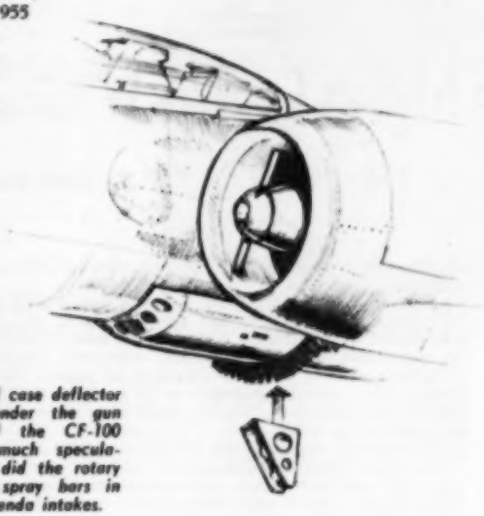


(Left) Root fairings on the moving tailplane of the D.H.110 are remarkable for their flat rear faces, made to fit carrier lifts.

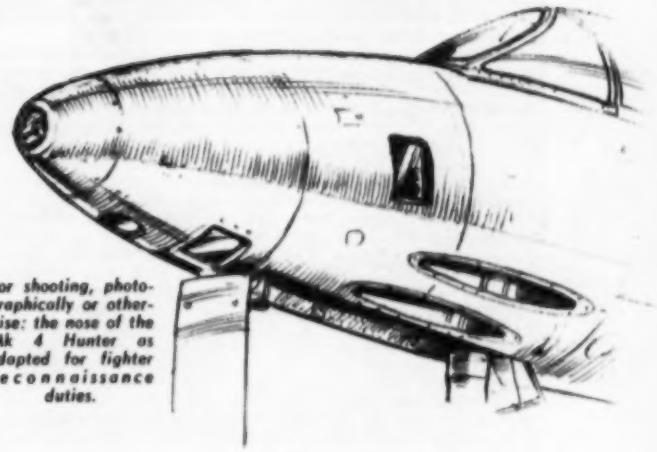
(Right) A periscope assists forward vision from the rear (instructor's) cockpit of the Gannet T. Mk 2.

(Below) The all-moving tail and smaller elevator of the Swift F.R.5; the Mk 4 is similarly modified.

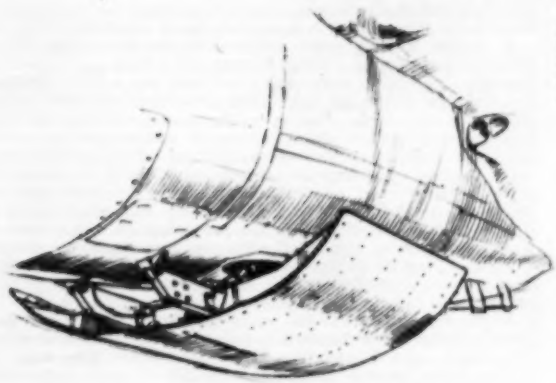




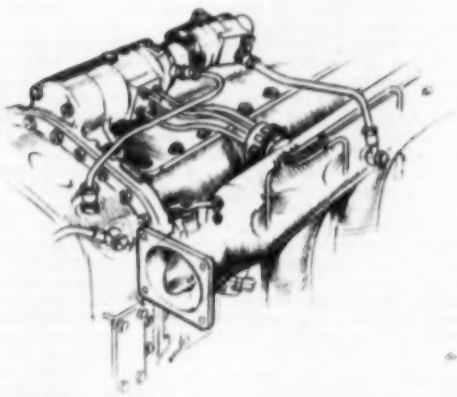
Link and case deflector plates under the gun pack of the CF-100 caused much speculation, as did the rotary anti-ice spray bars in the Orenda intakes.



For shooting, photographically or otherwise: the nose of the Mk 4 Hunter as adapted for fighter reconnaissance duties.

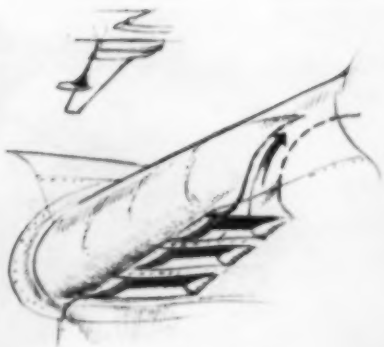


The forward, belly-mounted experimental air brake of the D.H.110 can be selected alone or in conjunction with the after lower air brake; there is no longer an upper brake. This "barn door" lies under the gun pack.

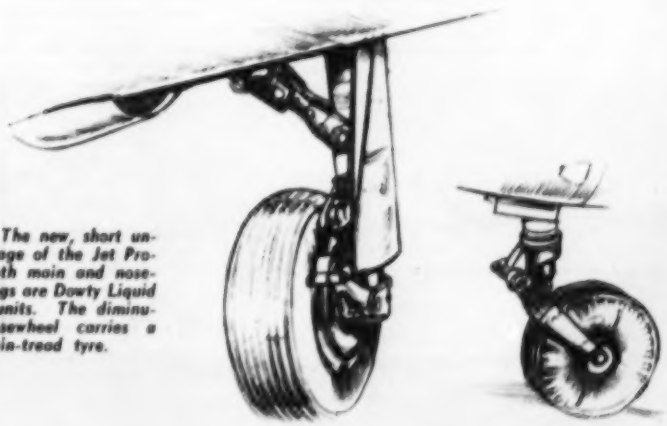


The fuel lines from the Gipsy Major 200 injection pump enter the induction manifold at a common union and are then led inside the manifold to their respective nozzles. Distribution is excellent.

An unusually interesting sandwich construction, seen in the static show, was Essex Aero's "Con-San."



(Left) The fillets inboard of the Comet 3's wing tanks (now of Comet 4 size) contain slots to smooth the airflow.



(Right) The new, short undercarriage of the Jet Provost. Both main and nosewheel legs are Dowty Liquid Spring units. The diminutive nosewheel carries a twin-tread tyre.

ENTHUSIASM AT PAU

French Light Aircraft on Show at the R.S.A. Rally: Flying the C.P.30 Emeraude

THE steady and spectacular progress of light aviation in France shows no sign of abating, and it was on a note of confidence engendered by its own success (and the new announcement of petrol prices being halved) that the Réseau de Sport de l'Air held its eighth *rassemblement* at the aerodrome of Pau-Idron in the Basses Pyrénées on August 15th last.

Certainly, to any keen follower of the light-aircraft movement, this occasion could give nothing other than satisfaction, in both the number and the variety of types arrayed against a picturesque Béarnais background. In spite of some very poor weather over a large part of France, over forty aircraft arrived to take part in a most successful meeting which was excellently organized by the Aéro-Club de Béarn, the hosts of this year's assembly.

Undeterred by the weather, a steady stream of aircraft arrived during the afternoon of Saturday, August 14th and by the early evening the aerodrome had a gala air with its lines of parked aircraft all sparkling and polished for the occasion. The most prolific were the Jodel D.112 two-seaters, all very well turned out in a variety of lively paint-schemes. One aero-club from Creil had sent three Jodels which had been built together by club members and all equally presented in an excellently polished cream finish, their youthful and friendly occupants making a fine *équipe* indeed. Another Jodel was the property of an insurance broker, Jean Duval, who with the assistance of his charming wife had built "The Flying Snail," which now gets about the Duval business at a faster pace than implied by its name. As befitted the home of the Minicab there were several examples of this snappy little side-by-side two-seater on the aerodrome, and one of these, from the club at Le Havre, won the prize for the best built two-seater (against some shattering competition in workmanship and detail finish).

Other types present included numerous Bébé Jodels and a Turbulent, previously described in *Flight* but now sporting a sliding canopy affording the absolute in single seater luxury. Older types included Piper Cubs, Boisavia Chablis, Pipistrelle and R.A. 14, while the present race of light two-seaters was well represented by the slick Supercab of Albert Rébillon, the Hollerville Bambi, Brochet 81, and the undoubted star of the show, the Piel CP-30 Emeraude; many had hoped to see the Druine Condor arrive, but unfortunately Roger Druine was on holiday.

The CP-30 Emeraude. The opportunity to examine and fly the Emeraude was eagerly seized, particularly in view of the interest being shown in this type in the United Kingdom, where the design is being investigated by the Popular Flying Association for amateur construction. A strong point in favour of this type is that it has completed and passed all the tests for a normal-category Certificate of Airworthiness in France. Additionally, it was recently classified first in the competitions for French light aircraft sponsored by the Fédération Aéronautique Nationale.

This aircraft is the brain-child of Claude Piel, whose CP-20 Pinnocchio, a model Spitfire, has already received wide acclaim and now earns honest bread and butter at the aero-club at Mitry near Paris (where members fly it at 25s per hour); it has flown some four hundred hours on its little Volkswagen engine. The Emeraude is a logical two-seater extrapolation of the Pinnocchio and is an all-wooden low-wing monoplane of pleasing lines, retaining without undue complication the classic "Spit" planform in its wing construction. The engine is the ever-popular Continental A-65 neatly cowled and blended into the squat-looking fuselage.

Claude Piel has the intention of producing a touring and sporting aircraft of good lines and yet so designed that it may be reproduced by amateurs. Although the wing appears elliptical the centre four metres are of parallel chord with similar ribs, the remaining portion being so arranged to achieve the elliptical shape. The wing datum line is at 25 per cent chord, which is also the spar location. Dihedral angle is nearly six degrees and the aspect ratio is 5.9.

The aerofoil section is the widely used NACA 23012 set at 3 deg 40 min incidence at the root and washed-out to zero at the tip. The spar is a boxed structure on to which the ribs are threaded and supported in their correct location by a false spar which provides the support for the aileron and flap hinges. There are some 24 ribs of which ten are made in the same jig, two special ribs being laid diagonally in typical sailplane style to transfer drag loads. Torsion is resisted by the ply leading edge, which is 2 mm thick at the root, reducing towards the tips to 1.6 mm. Attachment to the fuselage is simple, there being two main attachment bolts. The aircraft is completely fabric-covered.

A simple Warren girder structure composed of two flanks boxed up to two main fuselage-frames and a stern post forms the fuselage. The cabin interior is lined with ply, which stabilizes the structure and at the same time gives an attractively smooth interior to the cabin. The top of the fuselage is a typical light former-and-stringer assembly. External stringers are applied to the main structure before the application of the fabric. The main cabin top-hamper is formed by a sturdy welded-steel tubular frame—with a sensible handhold which will take the weight of a pilot without its falling off. The front screen is developed from the flat, while the rear structure of the cabin is attractively curved and fitted with two rear-vision panels also developed from flat pieces. Doors open forwards; they are welded steel frames, depending on the material characteristics for their stiffness and fitted with jettison release-pins.

In the forward part of the cabin there is an 80-litre fuel tank installed between the fireproof bulkhead and the instrument panel. The gauge is the dependable and simple cork-and-wire type.

The flying controls are completely conventional, with cable operation from slightly short control-columns and balanced-type rudder pedals basically similar to those of most Austers.

The whole aircraft has a most purposeful appearance and achieves a balance of line rarely seen in such small machines—the appearance invites one to leap in and fly. Entry is simple and the cabin is very roomy. The windscreen and cabin top look low but in fact seemed to cause no embarrassment to the Emeraude's six-foot designer. The instrument panel has an imposing appearance, being nicely rounded and smooth, and having a most complete set of instruments fitted. These include a directional gyro and also a rate-of-climb indicator, which is a popular instrument on French light aircraft, whose pilots are so often soaring-conscious. The engine controls were particularly pleasing, there being a sturdy yellow-handled throttle lever for the left-hand seat and a central push-pull knob to provide dual control, thus catering for all conditions of hands and habit. Additionally, a companion lever to the left-hand throttle provides control for the carburetter heat, a much more practical device than some of the silly little wires on so many other types.

The CP-30 Emeraude flown by the author of these notes; and one of its welded-steel-tube, forward-opening cockpit doors.

Suggestive of an earlier design-era, but looking capable of hard work: the Holleville Bambi.

(Below) The Girouette Constantin stabilizing device fitted to the Jodel Grand Tourisme.

Running true to form on French light aircraft, there was no direct-vision panel—perhaps they just don't have English weather or steamed-up windscreens in France! The trimmer on the prototype is a simple push-pull affair in the roof and seems insignificant in effect; this point could certainly be improved.

With the engine running the cabin is not noisy and conversation is easy (an equally important factor, if light aircraft are to catch on in modern society, is that the external noise is attractively low-pitched). Taxying is simple even without using the hydraulic brakes, and the squat lines of the aircraft, coupled with a wide track, give a secure feeling while dashing across a rough surface such as exists at Pau. The spring-leg cantilever undercarriage certainly suffered a trying test during a day's programme of trial flights by a variety of pilots.

On opening the throttle there is a slight left swing, easily corrected by rudder, following which it is necessary to hold the aircraft with its tail properly off the ground. Dragging off just won't work but, left to itself, the Emeraude is cleanly airborne and, once having accelerated to safety speed, climbs away at a reasonable angle. On this occasion, with two up, full tanks and outside air temperature 27 deg C., the rate of climb was some 650ft/min at a climbing speed of 65 m.p.h.

On levelling out and trimming for level flight one is conscious of a real little aeroplane with attractively sensitive controls which, in turns up to the vertical, are beautifully harmonized. The rate of roll is exceptional; the aircraft flown was fitted with little experimental end-plates as befits fashion, but whether they had any appreciable effect it is difficult to say. Certainly they seemed to have no adverse effect. During the climb the longitudinal stability was just positive, while laterally the stability seemed marginal. Directional stability was positive. All controls were pleasant and, when subjected to short-period oscillations, adequately damped. The elevator was personally considered too light and a check on its ability to pitch the nose following a simulated engine failure was highly successful.

Sideslips to the left with engine on were satisfactory, releasing either or both controls resulting in the nose pitching down and the aircraft straightening out. To the right there seemed to be some tendency to enter a descending turn when the rudder was released. Diving results in a rapid build-up of speed, the controls becoming very positive while at the same time staying reasonably light. Although on this occasion it was not possible to undertake a stalling programme, an approach to the power-off stalling attitude resulted in adequate control being available and (unusual in a small aircraft) a warning buffet. Gliding is pleasant, the controls being crisp and positive at the approach speed of 60 m.p.h., which is followed by a firm arrival. It seems difficult to bounce the Emeraude and its landing is very positive, with good control and shock-absorption. Naturally the flapped version is superior to the example flown and as a personal preference three inches more on the length of the legs would help.

Taken all round, the Emeraude is most attractive and should provide a most useful mount for the private owner who wants to fly cheaply at 100 m.p.h. Some twenty are under construction by clubs and amateurs, and a batch has been ordered from the designer's works (one example was seen from the air at Angouleme on the return journey to England). For those wanting a snappier performance the 90 b.h.p. Continental with starter and generator is available.

A test programme on the Emeraude is being undertaken by the British Popular Flying Association and, following the satisfactory progress of investigations to date, the first plans of the machine are already in this country.

Other Aircraft at Pau. Although of somewhat straight and simple lines, the Jodel D.112 two-seater has been developed by certain small manufacturing firms for the private-owner market, which in France is blessed by a subsidy aimed at encouraging a light-aviation industry. One such example at Pau was the Grand Tourisme model, produced by the Société Aéronautique Normande, which is at Bernay. This little firm produces a spatted and attractively finished Jodel fitted with an 85 b.h.p. Continental complete with starter. Many minor points have been improved, including the trimmer-control positioning, and a direct-vision panel has been introduced. Also fitted as standard is an S.A.N. six-channel V.H.F. radio produced by the same company and, following latest practice, using a roof-mounted loudspeaker. The performance of this set is good and, recently, examples were taken with a French team to the German gliding contests, where this radio was the only type to stay serviceable throughout the period.

As an indication of the use of an ultra-light aircraft as a research tool the particular Jodel Grand Tourisme at the rally, F-BDHA, flown by its owner, M. Lucien Querey (director of S.A.N.), was most interesting. The aircraft is fitted with a device known as the Girouette Constantin, which consists of an inclined sensing-vane mounted on an arm forward of the wing leading-edge and free to swing laterally. Any lateral movement is transmitted to the ailerons, and this is intended to alleviate dutch rolling while at the same time simplifying the pilotage of the aircraft. In effect, on a bumpy cross-country trip, the device is almost a co-pilot.

With the aircraft trimmed fore and aft into straight and level flight any tendency to slip or skid is sensed by the vane, which swings laterally; by interconnection, the ailerons are moved in the appropriate sense to keep the ball bank-indicator central. The stick can be left entirely free and all necessary turns or course adjustments can be made by rudder alone. A twenty-minute trial flight in the aircraft was very satisfactory and, even in the quite severe bumps around the local hillsides, the stick was hardly ever touched. For landing all that was required was to trim the aircraft downwind on the glide and then sit back with arms folded until ready to check for touchdown, the turns on to base leg and final approach being simply a matter of pushing on the rudder pedal. The device has caused great interest in France, where it is intended to develop a more compact installation without the somewhat complicated linkage of the existing experimental version. The prototype has been supported by the Service de l'Aviation Légère et Sportive, who purchased the wing, while many of the calculations were made at the Laboratoire Eiffel.

Two other aircraft were flown by the writer, the first being the dainty little Turbulent by Clochez, who this year deservedly won the R.S.A. cup for the best constructed amateur aircraft. Last year this aircraft was *hors concours*, having won the cup previously the year before. The sliding hood now fitted to the Turbulent has been very neatly installed and gives no impression of having been added afterwards. It can be locked in three positions, and flying in the hot sun with the hood slid back to its first notch was delight indeed. A half-hour flight confirmed previous opinion that here is a delightful little craft for the true amateur enthusiast. In a discussion with one of the French pilots of the

ENTHUSIASM AT PAU . . .

M. Clochez wags an admonitory forefinger over his prize-winning Druine Turbulent.

Centre d'Essais en Vol, it was obvious that the Turbulent was regarded very highly. It is hoped to have this example in England in the immediate future, and construction of several has already begun over here.

This year's *hors concours* aircraft was a Brochet 81 built by the aero-club of the Renault motor works. Such is the amateur status of the R.S.A. that this aircraft could not win the prize because a professional paint-sprayer had been involved in applying the finish. The Brochet is a conventional looking tandem-seat high-wing monoplane powered with a Hirth engine of 105 h.p. It has several features in common with the Piper Cub and Auster from an external appearance, but is of wooden construction. The cabin is very wide and comfortable, with everything well placed. The flying characteristics are very good and, while not in the "snappy" class, are pleasant. The trimming, in particular, is perfect; instruments are very complete and the basic instruments are duplicated in the rear seat. This aircraft seems excellent as a club trainer. A good feature is the door opening vertically on each side in one piece (just the thing for hot weather flying or photography).

Although the Volkswagen and Continental flat-four engines are now well established, development is proceeding to produce new motors. The news of the successful tests of the British Coventry Victor Flying Neptune was very well received. In France the latest motor is the vee-four two-stroke Lutétia of 44 h.p., which has been fully type tested and is very neat and compact. For the show it was present in a Bébé Jodel and certainly gave the little single-seater a sprightly climb.

As at each *rassemblement* there was, in addition to the flying programme, a banquet dinner, which this year was held in the municipal casino at Pau. Among the guests were M. Roger Pellevoizin, the president of the Fédération Nationale Aéronautique, M. Agesilas, the director of the S.A.L.S., accompanied by his deputy, M. Melchior; M. Bourlanges of the Bureau Veritas, himself a constructor of a Bébé Jodel; Albert Rébillon, surely the most active of French rallyists, and M. Bonneau, test pilot of the French flight-test centre. Additionally there were representatives of the A.R.B., Popular Flying Association, and the S.G.A.C.C. The R.S.A.'s president, M. Beraud, made an eloquent appeal for realistic official support for a nationwide programme of simple landing strips which the increasing number of light aircraft could use without difficulty and formality. It is an unfortunate fact that, for example, in the region of Tours (one of France's greatest provincial and tourist towns) there is no facility for the air tourist or airborne business man within about 45 miles, yet there are numerous spots where a 600-yard strip could be laid down without difficulty. At the banquet there were few speeches, but plenty of applause for the winners of the various cups and awards.

For the day following, two delightful programmes were arranged, the first being an aerial picnic to Biarritz, while those who preferred could go by car to a picnic in the Pyrenees. Monsieur Laure, the president of the Aéro-Club de Béarn, certainly had every reason to be proud of the excellent organization of the meeting, which proved a resounding success. In passing it might be mentioned that this national meeting was held only one month after a regional meeting of ultra-light aircraft had been held, at which 21 amateur-built aircraft had been present. This was at Yvrac aerodrome, at nearby Bordeaux.

It was noticeable at the rally that there was no attempt to "milk the public" and that the whole show was arranged solely for the fun of enjoying a weekend of amateur flying. Some participants camped on the airfield, others in dormitories and some in hotels, depending on choice, but all were there for one thing only—as the technical discussions around each aircraft showed.

A particular feature of R.S.A. meetings is the flying discipline, all the members taking their president's exhortation to prudence very much to heart. The only real clanger dropped was by an Englishman (his anonymity is safe with *Flight*) who blissfully and in serene loneliness was carrying out left-hand circuits in the Turbulent after the landing tee had been changed and everyone else was doing right-hand circuits.

An encouraging feature of this programme of prudence has been a reduction of 50 per cent in the number of accidents, and the trend is now very much in the right direction. Unfortunately, until results showed otherwise, there had previously been a widespread tendency to treat the little aeroplanes with contempt in respect to good flying technique, and several pilots were victims of the "girl-friend's house circling trick," which in France is called "Bonjour-Bonjour."

During the long flight back it was possible to reflect at length on the whole business of light aircraft and their operation. While, in the United Kingdom, light aviation has taken a most undeserved beating, there is still the hard core which can be developed again into something useful. Perhaps the shortage of air crew of the "right type," so recently bemoaned in high quarters, could be rectified if a similar spirit with little aeroplanes was allowed to develop, as has happened with small boats and those who "mess about in them." It is very easy to find reasons why it apparently cannot be done, but it *can be done* if the exhortation which was written on the side of a Grahame White seaplane of many years ago—*Wake Up, England!*—is followed.

H.B-D.

Ineligible for the R.S.A. Cup because its paint was professionally sprayed: the Brochet 81 (105 h.p. Hirth).

THE JET FLAP

(*continued from page 546*)

So much for the jet flap. The N.G.T.E. stress the fact that it requires a wholly new sort of flying machine, and should not be considered as an adjunct to existing fixed-wing aircraft. No one yet knows the best arrangement for stability and control, and the knowledge of jet-flap wings can be compared with our pre-Prandtl/Lanchester knowledge of ordinary wings at the turn of the century. Obviously there are drawbacks, one of which is the mechanical difficulty of making such a wing, and another is the inevitable loss in the ducting.

Anyone criticizing the idea could certainly pick on specific features which, on balance, are bad. On the other hand, it has never before been possible to achieve anything like so much lift from a given size of wing, and the chances are that the arrangement will become tremendously important and widely used in the future. At a rough guess, it seems that the overall efficiency of such a wing should be roughly the same as that of current fixed wings, but there will be the added feature of enormous lift coefficients for low-speed flight. One might ask what the result of such a lift coefficient would be on a present aircraft; at a rough guess, it could have a DC-3 airborne after a 40ft run.

Naturally enough, a propulsion system of the type proposed would probably require a new form of powerplant for optimum efficiency. One solution might be the use of literally dozens of miniature turbojets, of the type so long propounded by Dr. A. A. Griffith, of Rolls-Royce. Alternatively, it is not beyond the bounds of possibility that some new (and perhaps flat) engine may materialize by the time the jet flap becomes fully developed.

The N.G.T.E. developments are, of course, covered in Britain by patents held by Power Jets (R and D), Ltd. A Royal Aeronautical Society Main Lecture on the subject is scheduled to be given on October 20th by Mr. I. M. Davidson, one of the N.G.T.E. aerodynamicists responsible for its development.

W.T.G.

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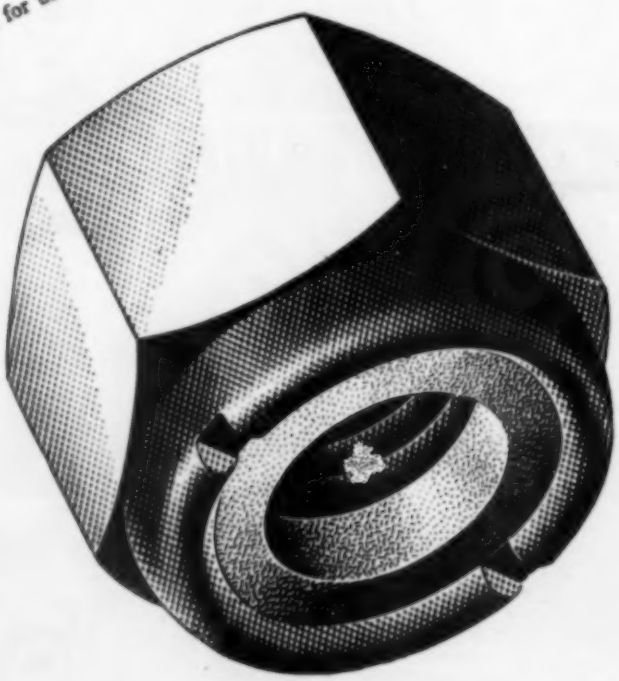

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CRC 15A

The Technical Side of Test Flying

Current Methods of Collecting Data Discussed at S.L.A.E. Lecture Meeting

At a meeting of the Society of Licensed Aircraft Engineers held in the main assembly hall at the Royal Aircraft Establishment, Farnborough, on September 5th, a paper entitled "Engineering Aspects of Test Flying" was presented by the two co-authors, Mr. C. F. Bethwaite, B.Sc., superintendent of the flight test department of A. V. Roe and Co., Ltd., and W/C. P. Brown, O.B.E., manager of the same company's experimental department. In the chair was the Principal of the R.A.E. Technical College, Mr. R. D. Peggs, M.A., who is one of the Society's honorary members.

The first part of the lecture was read by W/C. Brown, who began by expressing regret that security regulations did not permit him to give details regarding the flight development trials of the Avro Vulcan, with which he was associated. He then outlined, in general terms, some of the problems which were to be expected in the flight testing of modern aircraft and which were of particular interest to the maintenance engineer.

It was, he said, a vast subject, each aspect of which constituted a study in itself. One of the most important was that of instrumentation, which played an essential part in the flight testing of a modern aircraft. In some prototypes no less than 100,000ft of cable was used for the instrumentation system alone and, where a pressurized cabin was employed, the cables had to be routed through the pressure bulkhead to the automatic observer. For this purpose, bungs of proprietary manufacture were normally used and allowance had to be made for them in the design stage. It was, in fact, desirable that allowance should be made for more entry points than appeared to be necessary initially, because it often transpired, in the course of the test programme, that readings from additional points in the airframe were called for.

With a prototype aircraft it was rarely possible to carry out an intensive flying programme. Factors which contributed to delay were defects in the airframe and equipment which came to light during the tests; but the greatest retarding factor in a prototype's development was the incorporation of modifications to improve the aerodynamic efficiency. Structural defects of a major nature were few and far between but, sometimes, minor defects in the secondary structure, i.e., skin, ribs, etc., would be revealed during daily inspections. In these inspections far more attention was paid to detail than would normally be the case with a proved design on operational service; and, if trouble was experienced, it was essential to call in the design office at an early stage.

Flying-control Tests

The rectification of defects in the flying-control circuit was a study in itself and consisted mainly in the elimination of friction and lag. Since the maximum friction allowable in the circuit was 2½ lb, it was understandable that a close study of the sources of friction was necessary. In a modern powered-control circuit the instrumentation often included as many as 120 strain-gauges and accelerometers with the equivalent number of Dessyn indicators.

Defects in equipment were the cause of by far the greatest amount of unserviceability experienced in the flight-test programme. The basic aircraft design was usually well ahead of that of the equipment on which its operation depended. Such items as fuel and oil leaks were a common source of trouble as, also, were electrical faults. It could happen that the whole aircraft would be considerably delayed for a defect in the intercommunication system, although it might be fully serviceable in other respects.

The lecturer concluded by saying that much attention was paid throughout the test programme to ensure that provision was made for ease of maintenance on the machine. This aspect included the design of special tools and modifications where necessary to improve accessibility. W/C. Brown then showed the meeting an interesting film depicting the salvage operation on one of the prototype Vulcans which had overshot the runway and come to rest on its belly in the field beyond. The film sequences showed how the aircraft was lifted by 25-ton jacks, with airbags under the wing as "steadiers." When sufficient ground clearance had been obtained the undercarriage was removed and a trailer was backed under the fuselage to transport the machine to the repair shops. The whole operation was completed within 48 hours of the incident and the aircraft was able to fly back to base after five weeks.

Mr. Bethwaite then presented his part of the joint paper. Every generation of aircraft, he said, brought its own particular problems and new techniques and methods were being developed to keep pace with the new requirements. They had tried to make test flying a scientifically controlled experiment and most of the recording of data was now performed automatically. The test pilot was, however, still the final assessor of a new aircraft's characteristics. The objects of test flying were:—

(1) To ensure that the aircraft's flying characteristics met the requirements of the operational pilot as far as safety and being pleasant to fly were concerned.

(2) To ensure that the performance was up to the standard required by the design specification as regards speed, ceiling, fuel consumption, etc.

(3) To ensure that the aircraft was a good engineering product and that maintenance was simple and straightforward.

The first priority was that the machine should be safe and pleasant to fly, and the early part of the flight-test programme was the most crucial in the life of the aircraft. It was during this period that any major faults in design would come to light. After this came the performance trials, when the function of the essential services was checked and any faults rectified. Faults at this stage were regarded as a nuisance, but their correction was of great importance, because the design was then being finalized. Finally came assessment by the constructor and by the acceptance authority. The total time taken to produce the final machine might appear to be rather long, but a complicated series of tests had to be completed. The time factor could be reduced considerably by having six or ten prototype aircraft with which to work instead of the normal two or three.

"Handling" in Practice

Handling quality in the air was most difficult to forecast accurately. It had never been found satisfactory to meet the requirement by means of wind-tunnel testing, as slight distortions of the aircraft in flight could alter control characteristics. The factors which the test pilot took into account were control forces, control movements and rate of response. Attempts had been made to formulate numerical requirements for these factors, but with little success, as they were subject to continuous change. For example, a similar stick-force was required to produce 4 deg of elevator movement at 200 kt as to give 1 deg at 400 kt. The influx of power-operated controls had brought with it a new set of problems in providing the pilot with an artificial feel, but these could normally be solved on the ground with a test rig.

Stability was another problem to which great importance was attached. Until recently, static stability had occupied the primary position, but now measurements to determine dynamic stability were also made. Complications were introduced at high Mach numbers, since the forces acting upon the aircraft depended both on airspeed and on Mach number; and when stability characteristics were being measured in a dive, for instance, it was not possible to keep both factors constant at the same time.

Mr. Bethwaite went on to outline some of the problems connected with instrumentation and the testing systems and services. The instruments in a modern prototype could be divided into several distinct categories: (1) Normal flight instruments; (2) gyro instruments, to indicate the attitude or rate of change of attitude of the aircraft; (3) Dessyn and Selsyn indicators, to record the position of moving parts such as control surfaces; (4) accelerometers; (5) force- or load-measuring devices of the strain-gauge type; (6) pressure indicators of the capsule type; and (7) temperature recorders based on the thermocouple principle.

Use of Trace Recorders

In all, between 80 and 100 instruments were to be found on a modern prototype. On any particular flight recordings from perhaps only ten of these were related to the particular test, but it was good practice to obtain records from all of them, as these would prove useful at a later stage. The testing of systems and services was more a matter of statistics than of individual flight tests and their serviceability was determined over a series of tests.

Until recently, the method used to record data was by means of a ciné-camera photographing the complete instrument panel, but this means was now being superseded by various types of trace recorders. These devices had certain limitations as regards accuracy and the difficulty of identifying the particular trace required; but, as far as the last-mentioned was concerned, a recent development by R.A.E. was that of a trace analyser which simplified the procedure considerably. Trace recorders were used widely at the present time and it was expected that future developments would enable the engineers to obtain the results of any particular test within half an hour of completion of the flight, a significant factor in the reduction of the total development period.

Mr. Bethwaite concluded by saying that flight testing was

THE TECHNICAL SIDE OF TEST FLYING . . .

essentially a team job calling for the maximum co-operation between the design office, the technical flight-testing staff, the pilot and the maintenance engineers. Constructive criticism was a part of the duties of the flight-test engineers, who should have some knowledge of the design problems, but the key to success in reducing development time was complete co-operation.

THE DISCUSSION

MR. PARRY (D. Napier and Son, Ltd.) asked what were the possibilities for the use of telemetering in connection with the flight testing of modern prototypes. Mr. Bethwaite answered that the possibilities were enormous but he did not visualize that telemetering would entirely supersede other methods. It was a good insurance policy to make use of the facility in testing high-speed aircraft.

MR. A. J. GOODING (Field Aircraft Services) inquired what accuracy could be obtained with the use of strain-gauges for measuring small forces. Mr. Bethwaite threw the question open to the meeting and it was answered by MR. R. L. HOWARD (Films and Equipment, Ltd.) who said that it was difficult to be specific since a force could not be measured unless there were a strain involved, and it was usual to insert a weak link in the system to provide for this.

MR. MOORE (W. Vinten, Ltd.) asked Mr. Bethwaite whether he considered the use of the photo-recording method had been made obsolete by the development of the trace recorder. Mr. Bethwaite said that photo-recording was by no means obsolete; it was a question of using whichever method was more suited to the particular job.

MR. C. M. BRITLAND (R.A.E. Aerodynamics Dept.) also thought that there would be many applications for photo-recording for some time to come. He suggested a profitable line of research for camera manufacturers would be the development of equipment which would operate under conditions of the high temperatures likely to be encountered with modern high-speed machines. He asked W/C. Brown whether, in view of the time wastage due to trivial failures in the instrumentation system, it would not be better to duplicate many or all of these services for test purposes. W/C. Brown answered that duplication was a sound scheme, but a drawback was that it might give a misrepresentation of the system which was being checked.

MR. WILLIAMS (Handley Page) referred to the trace-recording method and suggested that there might be some difficulty in distinguishing between buffet and vibration on the trace. He also asked whether it was considered necessary to calibrate the instruments before and after any particular flight. Mr. Bethwaite said that, although there was some difficulty in calibrating instruments before and after flight, it was imperative to do so, otherwise the flight test engineers might find themselves on a wild-goose chase. If it was not possible to make a full calibration, at least the relevant instruments for a particular test should be checked.

MR. D. F. WRIGHT (R.A.E. Structures Dept.) mentioned that his establishment had produced a new type of computor for analysing flight-test data and it was, in fact, on display on the M.o.S. stand at the Farnborough Exhibition. It was like a "sausage machine" in that the questions were fed into one end and the answers came out of the other. Mr. Bethwaite said that he was aware of this equipment and hoped that further similar developments would be forthcoming in the future. It was desirable that such a device should be able to produce the required answer fully corrected and, if possible, computed, shortly after completion of the flight.

MR. R. L. HOWARD commented that if one was not careful the use of these "sausage machines" would involve a greater delay in obtaining the required answer than by using more conventional methods, since they were not capable of being interpreted on the spot by the flight-test engineers.

THE TITMOUSE—A NEW LIGHTPLANE

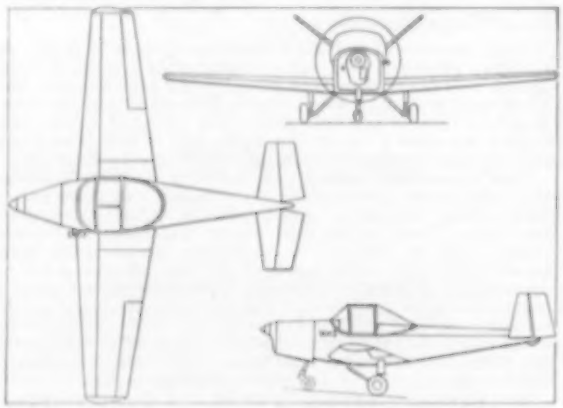
EXHIBITED in model form on the Tiltman Langley stand in the exhibition tent at this year's S.B.A.C. show was an attractive two-seat light aircraft known as the Titmouse. It is the result of a spare-time design study by members of the company's technical staff, and appears a logical design for a modern club aircraft. At present, the company has no plan for sponsoring the construction of the Titmouse, although official encouragement has been given to the enthusiasts responsible.

The specification contained in Annexe "B" of the *Preliminary report of the Special Advisory Committee on Private Flying* (M.C.A., 1947) was taken as a basis for the initial design, although it was felt that this called for a rather more elaborate aircraft than was actually needed. In order to keep the cost low, special attention was paid to simplicity in design and manufacturing method. At the start it was decided that the maximum use was to be made of fabricated parts, so that forgings and castings could be completely excluded and the entire airframe produced as sub-assembled units on the bench, using little more than ordinary hand tools.

Seating two persons side by side, the Titmouse is intended as a fully aerobatic training and touring aircraft. An all-metal airframe is employed, with metal and fabric skinning. A Cirrus Minor Series II 90 h.p. engine provides power through the medium of a two-blade fixed-pitch wooden airscrew.

The fuselage skinning forward of the rear spar is of light alloy, and fabric covering is employed aft. The seats are located between the spars leaving a well forward of the front spar clear for leg-room. A baggage compartment is provided beneath the rear decking behind the seats. The canopy contains no double-curvature panels, and the sliding portion locks in the closed position against the crash member, which also forms the windshield frame.

The wings are straight tapered and of symmetrical section, the same assembly jig being used for both port and starboard assemblies. The main channel-section spar is situated at 30 per cent chord and forms the closing side of the metal leading edge torsion box. A light spar at 70 per cent chord carries the aileron hinges and the undercarriage compression leg attachment. The ribs are made in three chordwise sections—nose, interspar and trailing edge. Fabric covering is used aft of the front spar. A simple one-piece flap is provided beneath the fuselage. The tail unit is a welded tubular structure with fabric covering, and its angle of incidence is adjustable on the ground. Elevator trimming is obtained by spring-loading the control column.



This ashtray model gives a fair idea of the Titmouse's appearance.

Dual flying controls are provided. The stick mechanism is housed beneath the seats and the control cables from the rudder pedals are fed through a central trunk which runs aft between the seats. This trunk also provides a mounting for the centrally placed throttle, trimmer and flap levers. The throttle lever is duplicated on the port side.

The tricycle undercarriage is of welded steel tube construction and employs rubber blocks in compression as the shock absorbing medium. The nosewheel is castoring and the main wheels are differentially braked by cables *via* the rudder pedals and a lever on the port control column. All tyres are of the low-pressure type.

The ten-gallon fuel tank is located under the forward decking between the instrument panel and the firewall and is contained within a sealed fireproof compartment. The oil tank is mounted on the forward side of the firewall.

Loading data: Span, 27ft; length, 21ft; height, 7.5ft; wing area, 121 sq ft. Empty weight, 770 lb; gross weight, 1,200 lb; wing loading, 9.9 lb/sq ft. Maximum speed, 132 m.p.h.; cruising speed (80 per cent power), 123 m.p.h.; stalling speed with flaps up, 50 m.p.h.; endurance, 2 hours at 80 per cent power; range, 200 miles.

LEONIDES MAJOR PROGRESS

3,000 Hours' Bench and Air Running Completed

"Flight" photograph

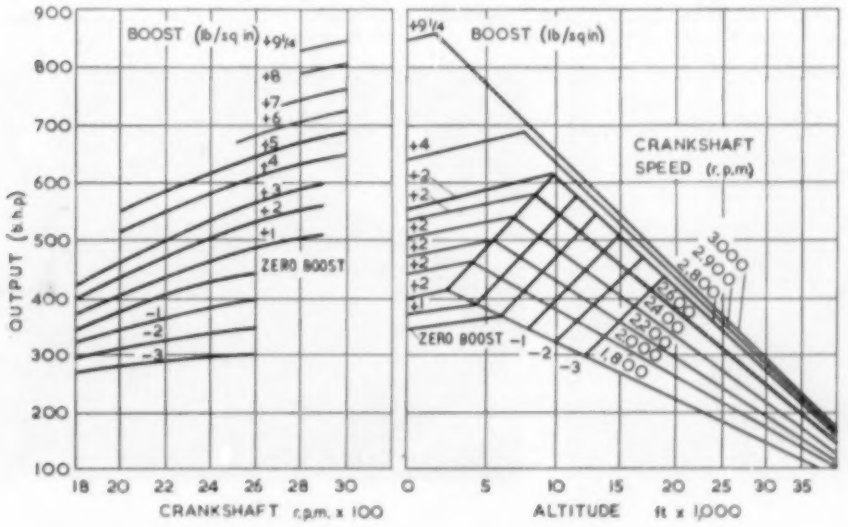
SEVERAL aircraft—both fixed-wing types and helicopters—are now flying on the power of the new Alvis Leonides Major, and this engine has now acquired considerable importance for both civil and military projects. At this year's S.B.A.C. Show it was seen airborne in public for the first time, in the Handley Page Herald and in the Westland Whirlwind.

The single-row Leonides has given extensive service in Provosts, Princes, Pioneers, Dragonflies and Sycamores, and the two-row 14-cylinder Major, which was developed from it, has now completed some 3,000 hours of bench and airborne running. Progress towards type-testing at the designed power is reported to be satisfactory, and an internal modification will enable the type-test at a guaranteed minimum of 850 h.p. to be completed in the near future. This modification is the stiffening of the cam ring, since differential expansion of the steel ring and the forged alloy crankcase was seen to cause inefficient valve operation, which in its turn led to a power of only 825 h.p. in two "dummy run" type-tests carried out earlier. With the 4 per cent minus tolerance in power which has to be allowed for in the first twenty engines submitted for the official power rating to be set, a guaranteed 850 h.p. is expected.

Engines now installed in the various aircraft are giving 825 h.p., since they have not yet been modified. The company's test-bed, the Marathon, is being used to complete 250 engine hours as soon as possible in order to establish this time as the initial overhaul period, but it is hoped soon afterwards to raise the period to 400 hr. By 1957, when the Herald is first due to be delivered to operators, overhaul periods will certainly be up to 400 hr, but in all probability will already have reached 600 hr.

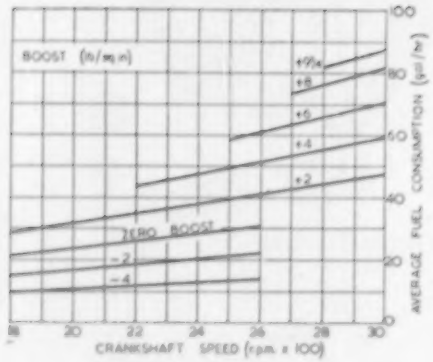
When, recently, a member of the staff of *Flight* visited Baginton and flew the Leonides Major Marathon it had already completed 140 engine hours without trouble. The test-bed nacelles are, of course, identical with those of the Herald, and it was clear that cooling and other items which are generally a function of the installation are all satisfactory. The cowling gills are electrically operated and oil temperatures can be easily controlled by them. In this first test-bed no particular effort has been made to relate the throttle movement exactly to power response—nor is any great alteration absolutely necessary. Response is a little slow over the lower range of throttle movement. The engines are,

Alvis Leonides Major	A.Le.M. 1-1	A.Le.M. 1-6
Position of crankshaft	horizontal	vertical
Number of cylinders	14	14
Bore (in)	4.8	4.8
Stroke (in)	4.41	4.41
Capacity (cu in)	1,117.8	1,117.8
Compression ratio	6.8:1	6.8:1
Supercharger ratio	6.535:1	6.535:1
Overall diameter (in)	38.925	38.925
Overall length with accessories (in) ...	70.896 (max.)	54.858 (max.)
Fuel grade	100/130	100/130
Maximum Take-off Power Rating		
b.h.p.	850	—
r.p.m.	3,000	—
Boost (lb/sq in)	+9¼	—
Altitude (ft)	Sea level	—
Fuel consumption (pt/b.h.p./hr) ...	0.80/0.85	—
Maximum Power Rating		
b.h.p.	870	—
r.p.m.	3,000	—
Boost (lb/sq in)	+9¼	—
Altitude (ft)	1,750	—
Fuel consumption (pt/b.h.p./hr) ...	0.78/0.82	—
Maximum One Hour Power Rating		
b.h.p.	—	860
r.p.m.	—	2,900
Boost (lb/sq in)	—	+9¼
Altitude (ft)	—	1,500
Fuel consumption (pt/b.h.p./hr) ...	—	0.78/0.82
Maximum Continuous Power Rating		
b.h.p.	635	635
r.p.m.	2,900	2,900
Boost (lb/sq in)	+3½	+3½
Altitude (ft)	8,500	8,500
Fuel consumption (pt/b.h.p./hr) ...	0.68/0.72	0.68/0.72
Maximum Weak Mixture Power Rating		
b.h.p.	515	535
r.p.m.	2,600	2,750
Boost (lb/sq in)	Zero	Zero
Altitude (ft)	11,500	12,500
Fuel consumption (pt/b.h.p./hr) ...	0.545/0.575	0.550/0.590
Weight		
Net dry weight to E.D.M. 25 (lb) ...	1,200	1,050

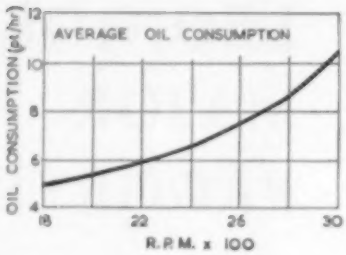


The nacelle of the Leonides Major in the Marathon test-bed is identical with that of the Herald, and is shown in the heading illustration with cowling gills three-quarters open. The petal cowling hinges just aft of the exhaust pipe and air outlet grille.

Sea-level (left) and altitude (right) performance curves for the present Leonides Major.



(Left) Fuel consumption of the Leonides Major. Specific consumptions are 0.78-0.82 pints/b.h.p./hr at take-off power, 0.68-0.72 pints/b.h.p./hr at maximum continuous power and 0.545-0.575 pints/b.h.p./hr at max. weak mixture power.



(Right) Average oil consumption of the Leonides Major plotted against r.p.m.

LEONIDES MAJOR PROGRESS . . .

however, very smooth and quiet and give a most pleasant ride. The de Havilland three-bladed, constant-speed, feathering airscrews are a slight modification of a standard pattern and will shortly also be fully type-tested.

Engine settings for take-off in the Marathon are plus 9 lb boost and 3,000 r.p.m., and for climb plus 3 lb and 2,900 r.p.m. are used. Normal cruising is at −0.5 lb and 2,600 r.p.m. and fuel consumption at −2 lb and 2,000 r.p.m. was measured at 22 gal/hr on the flow gauge. Oil temperature was 70 deg C with the gills three-quarters open; and I.A.S. at some 4,000ft, 120kt.

Various versions of the engine are already projected in addition to the standard aircraft model. One is the reverse-rotation type for the Whirlwind helicopter, and others for the Bristol 173 and the military 191 and its derivatives. For these the supercharger compression ratio will probably be increased to give a little more power. Graphs and tables of power and consumption figures appear on the preceding page and above.

CANADIAN P. AND W. PURCHASE

AN official announcement of the purchase by Canadian Pratt and Whitney Aircraft Co., Ltd., Longeuil, Montreal, of the Crown-supplied machinery and equipment for Wasp engine manufacture was made early this month by Mr. R. T. Riley, president of the company. Earlier news of the completion of negotiations for this purchase was given in *Flight's* Commonwealth Issue of August 26th.

In addition to this purchase, Mr. Riley revealed, the company was spending more than $1,500,000 (£540,000) on new capital equipment in connection with the R-1820 engine programme for the Grumman CS2F-1s being built under licence by de Havilland Aircraft of Canada and subcontracting firms for the Canadian Navy.

In the course of describing the company's future plans, Mr. Riley said that, "if the current trend continues," Sikorsky helicopters would soon be produced at the Longeuil plant for both commercial and military use.

MOBILITY IN AIRCRAFT HANDLING

SUBJECTED to progressive improvement after a prototype was put into service aboard H.M.S. *Theseus* in 1952, the battery-powered Lansing Bagnall aircraft handler illustrated in one of the photographs below, subsequently went into production for use at Royal Naval and R.A.N. air stations. Later a more powerful handler was developed, in accordance with a requirement which also stipulated flameproofing of the control gear, so that the handler could be used in carrier hangars.

The makers, Lansing Bagnall, Ltd., of Basingstoke, Hants, then turned their attention to the design of a handler which would be essentially suitable for R.A.F. use. In this equipment, known as the Type D machine, the "pallet ring" by which the handler lifts the aircraft nosewheel or tailwheel is dispensed with. Instead, there is the "claw" mechanism shown in the second photograph. A pair of three-finger jaws, equipped with pads which abut against the tyre, close on to the wheel and imprison it completely; they then lift it clear of the ground, and the handler can turn the aircraft (pivoting about its mainwheels) in a circle of its own length, or tow it in any desired direction.

Lansing Bagnall handlers are equipped with an electrical circuit which provides regenerative braking; and the Type D machine, in addition, has a rheostatic braking system which controls speed down to zero without recourse to the mechanical brake.

FILM ABOUT FORGINGS

RECENTLY shown in London was *Drop Forgings in Alloy Steels*, a 16-mm colour film, with technical commentary, showing various applications of products of the Firth-Derihon Stampings, Ltd., of Sheffield. In the first section of the film the production of gas turbine discs is traced, from a discussion of die-design factors to the etch-inspection methods for turboprops. Views of Westland Whirlwind rotor-head production are followed by a number of excellent S.B.A.C. Show flying sequences, illustrating various aircraft embodying Firth-Derihon forgings. The drop-forging of connecting rods for piston engines is also shown.

The second section of the film deals with the forging of gas turbine rotor blades manufactured in Nimonic nickel-based alloys. Blading for huge commercial turbo-alternators is also shown, in addition to various specialized uses of drop forgings, and a final section is devoted to gears. Copies of the film, which runs for 33 min, are available on loan to interested organizations on application to The Firth-Derihon Stampings, Ltd., Sheffield Road, Tinsley, Sheffield 9. (Sheffield 42051.)

One-man manœuvring of an Attacker by means of the Lansing Bagnall aircraft handler (see "Mobility in Aircraft Handling," above). (Right) The claw mechanism which, in the Type D handler, gently but firmly clasps the aircraft nosewheel or tailwheel before lifting it.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Rolling the Heavies

YOU refer in your leading article in the September 16th issue to W/C. Falk's slow-rolling of the Vulcan at Farnborough and you add a parenthesis that the B-47 has been rolled.

This is a startling revelation. Has the B-47 been rolled, as the Vulcan was, before a public assembly of thousands of spectators, or does the evidence rest on pilots' tales?

In a true slow roll there is a side-slip component and, unless the B-47 was barrelled on an enormous radius, the pods and flapping wings must have been in a bad way. The Vulcan's taut, compact configuration enables it—as thousands saw at Farnborough—to do a classic roll as cleanly as a fighter. It was a triumph of manœuvrability and of pilotage. But, with the greatest respect for a sound design, I would suggest that, if a B-47 were rolled, the things going on in the structure would bear some resemblance to what happens inside a cow when it is running.

Outwood, Surrey. OLIVER STEWART.

The Lofoten Route

I WOULD like to say how much I have enjoyed reading the article *The Lofoten Route* by your contributor Mr. C. B. W. Barford in your issue of September 9th.

In 1948 I flew from Oslo to Tromsö in a S.A.S. Sandringham, and thence to Vadsö in a Ju52. On the return trip I spent some time in the Lofotens, and felt very nostalgic after reading Mr. Barford's description of them. The only point he failed to mention was the beauty of the S.A.S. hostesses, which even made it difficult at times to look out at that wonderful scenery.

London. K. M. BURTT.

Two-make History

FOLLOWING your publication of "historical" articles during recent months, I hope the following comments on Boulton Paul and Fairey machines will be of some value.

The P.6 prototype was a rebuilt Camel fuselage with R.A.F. 15-section wings for flight trials, and had the civil registration G-EACJ later in its life. I think the Bourges F 2903 was flown first with the Bentleys because the A.B.C. engines weren't ready. This machine and F 2905 were later registered G-EACE and G-EAWS. The first P.8 Atlantic was surely F 2904 modified and re-engined—I had a photograph of the Atlantic showing R.A.F. markings and serial number anyway: the second Atlantic was registered G-EAPE. The prototype P.9 was registered G-EAPD and the Bugle 1 was numbered J 6985, being followed by two Bugle 2s, the one you showed and J 7267.

Surely the interesting feature of the little Phoenix was that there were no fixed tail-surfaces? S/L. Rea flew G-AAIT for the first time in July 1929, and the production version with the Salmson AD.9 had a long-stroke oleo-pneumatic undercarriage. The P.71 was laid down for Pegasus IIIM.3s—hence the "A" in the designation when fitted with Jaguars. That delightful old biplane, the Overstrand, to Specification B.23/34, was still flying during the war—K 4551, I believe, was flying in the winter of 1942. There were only a few built, apart from conversions, numbered K 4546 to K 4565 and issued to 101 (B) Squadron. And what about that incredible project, the Superstrand—with an extra bay of struts, Pegasus IV engines and, of all things, a retractable undercarriage!

F/L. G. S. Kelton flew the prototype Defiant, and the second prototype, K 8620, was used, I believe, for early wing and underwing armament trials. Prototype TT.1 was DR 942, and first flew in spring, 1942; the Defiant 2 prototype was N 1551 and first flew in 1940—this machine was later fitted with a Merlin 24—and the prototype TT.3 was N 3488.

To wind up, the P.92 scale-model, V 3142, was a test-vehicle for the F11/37 specification project; S/L. Price-Owen flew the Balliol 1 prototype from Bitteswell on May 17th, 1948, and the Balliol T.2 (Specification T.14/47) flew for the first time on July 10th the same year.

About Fairey's aircraft: Not long ago the company issued an advertisement showing the F.2 and describing it as the "first aeroplane designed and constructed by the Fairey Aviation Company"—the odd thing being that the date given was 1914, whereas I don't think the F.2 flew until early 1917.

Another engine fitted to the IIID that was not mentioned was the Lorraine-Dietrich, with the Rolls-Royce Eagle engine and amphibian landing-gear. The IIIF series has always been confusing, and I possess an official photograph of machine No. J 9154 (Fairey number F 1020) which is described as a Gordon—but on the fuselage is stencilled "IIIF Mk IVM W.P." I believe this airframe served as a prototype for both the Gordon and the Seal, for I have seen it with the modified fin and a tailwheel and hook. By the way, one of the early production Gordons, K 2743, was still on charge to R.A.F. Mediterranean in September 1941.

Number 38 (B) Squadron was the unit that had the Hendon night-bomber of which fourteen were built and delivered after the prototype, K 1695, had been re-engined with Kestrels and crashed after extensive flight trials. These production Hendons were numbered K 5085 to K 5098.

You didn't mention that the first Long Range Monoplane, J 9497, was lost when, again flown by Jones-Williams and Jenkins, it crashed in the Atlas mountains on a flight to South Africa in December 1929. The engine fitted in the second machine, K 1991, was the 600 h.p. Napier Lion XIA.

The G.4/31 specification was issued to find a general-purpose machine to replace the Wapiti, and Fairey's entrant, later numbered K 2774, was on trial with the machines of Vickers (K 2771), Parnall (K 2772) and Handley Page (K 2773). The Fairey G.4/31 was machine number 12 in the New Types Park at the Hendon Pageant in 1933.

I hadn't seen a Seafox on wheels until your issue appeared, and I don't think any machine other than the second prototype was so equipped. There were fifty Seafoxes built, numbered K 8568 to K 8617.

Wasn't the T.S.R. Biplane built to Specification S.15/33? The production-style Swordfish conformed to S38/34 (Prototype K 4190) and the three pre-production machines delivered for service trials were K 5660, 5661 and 5662. An incredible achievement with a Swordfish (among many others) was that of Sub-Lt. B. W. Rose, D.S.O., one of the few survivors of Esmonde's attack on the *Scharnhorst* and *Gneisenau* in the Channel in 1942. Sub-Lt. Rose's machine (W 5992, I believe) actually managed to fly away from the scene, after attacking, with two cylinders shot right off!

First two Albacores were L 7074 and 7075, both with spats and flat (as opposed to "tapered") N.A.C.A. cowlings, and the machines were first operational under the ægis of Coastal Command, bombing Boulogne in September, 1940.

Just one more thing—about the Fantôme/Féroce biplanes. I have seen somewhere, and noted, one of the British-built machines with the serial number L 9913—and I can remember someone telling me that it was the demonstration Fantôme, G-ADIF. I wonder if someone could tell us what happened to these machines?

Well, I suppose I must get back to the cooker. I hope the above will prove to be of some publishable value, if only to show that an ex-Ancient and Tattered Airwoman hasn't lost her grip under the strain of housewifery.

It was very good of Gerald Maxwell to correct me about McCudden's death. I was led astray by C. G. Grey's note at the end of my copy of *Five Years in the R.F.C.*

Invergarry, Inverness-shire. ERIKA I. ZAHN.

IN BRIEF

Mr. W. A. E. Featherstone, of 21 Garrick Close, Walton-on-Thames, Surrey, seeks the assistance of readers in obtaining a copy of the book *Over the Balkans and South Russia*, by the late H. A. Jones, published by Edward Arnold (Publishers), Ltd., and now out of print.

FORTHCOMING EVENTS

Sept. 28-30. Institute of Physics: 7...th Annual Conference of the Stress and Analysis Group, Sheffield.
Sept. 29-30. Aerocreme Owners Association: Annual Conference, Manchester.
Oct. 1-2. Innsbruck Air Rally: Innsbruck, Austria.
Oct. 4. R.Ae.S.: Graduates and Students Section: Informal Talk on Aircraft Structural Fatigue, by Dr. P. B. Walker, C.B.E., M.A., Ph.D., F.R.Ae.S.
Oct. 6. R.Ae.S.: British Commonwealth and Empire Lecture: "The Growth of Aeronautical Research in Canada during the Post-War Decade," by Dr. J. J. Green, M.B.E.
Oct. 7. Helicopter Association: "The Control of Helicopter Rotor Vibration," by P. R. Payne.
Oct. 10. Institute of Transport: Presidential Address by P. G. Masefield, M.A.(Eng.), F.R.Ae.S., M.Inst.T., F.I.Ae.S.
Oct. 19. R.Ae.S.: Graduates and Students Section: Rocket films.

R.Ae.S. Branch Fixtures (to October 19th):—

Oct. 1, *Halton*, Annual general meeting and main lecture, "Compound Engines," by A. C. Clinton. Oct. 3, *Halton*, Films. Oct. 6, *Isle of Wight*, "Recent Developments in Production Processes," by W. E. Gott. Oct. 12, *Manchester*, "Development of Guided Weapons," by W. H. Stevens. Oct. 17, *Halton*, Film and talk. Oct. 19, *Coventry*, "Cockpit Hoods," by Dr. Holland.

THE INDUSTRY

Production of Threaded Parts

IT is the claim of L. H. Newton and Co., Ltd., that every aircraft manufactured in this country incorporates their products; and, certainly, examination of a list of their current customers goes far to support the contention.

The products in question are bolts, nuts, screws, other threaded components and various machined details, manufacture of which we were able to see during a recent visit to the company's main factory at Nechells, Birmingham 7. Bolts are produced by cold forging, plus various finishing operations, to such British Standards as A.25, A.30, A.59, A.60, A.102, and A.111, and S.B.A.C. specifications such as AS.1248; screws are cold-forged to B.S. A.31-54 and similar specifications; and nuts are turned from bar stock to British Standards of which A.24, A.27, A.29, A.31-54, and A.58 are typical. Bolts, screws, studs and nuts in corrosion-resisting steels and light alloys are also produced.

Apart from the machined details, which form an apparently inexhaustable variety of shapes and materials, Newton's knowledge of thread-forming techniques (cutting, rolling or grinding) is so well founded that the company is sometimes called upon to perform difficult threading operations upon larger components. One example is the arrester hook for a well known type of Fleet Air Arm aircraft.

The cold-forging method, as used for high-tensile-steel aircraft bolts, is an impressive (if noisy) one to witness. Using wire stock, the machine forms a head by the upsetting process, parts the bolt from the stock, trims the head to the required hexagon form and dimensions, and chamfers the shank-end.

The blanks are next threaded, by cutting or rolling, and heat-treated; plating follows, usually with cadmium or zinc in the case of aircraft parts.

These processes are subject to close control at all stages, beginning with a laboratory check of setting-up to ensure correct grain-flow during forging and ending with a final A.I.D. inspection.

Turned aircraft bolts and screws are made in a wider range of materials than the cold-forged bolts, including as they do corrosion-resisting steels and light alloys. In all cases the material used is fully heat-treated before machining, which is performed on either capstan lathes or automatics in accordance with the quantities required.

Fully heat-treated material is also used for aircraft nuts, the threads of which are cut on automatic machines by precision-ground high-speed-steel taps. Inspection is, again, rigorous.

The Nechells works—one of the company's ten factories, which employ over 2,000 workers in all—gives the visitor the impression of being particularly successful in achieving its air of coupling quantity production with close quality-control. Mechanical handling, principally by overhead conveyors, is used to a considerable extent.

The new weighbridge hangar at the A. and A.E.E., Boscombe Down, has folding doors—at each end of the structure—second in size only to those of the Bristol Brabazon hangar. Built by Esavian, Ltd., the doors measure 297ft wide by 67ft high, and the four 5 h.p. operating motors pick up their current from an overhead-wire system manufactured by British Insulated Callender's Cables, Ltd.

Rear Admiral J. S. Russell, U.S.N., of the U.S. Bureau of Aeronautics, visited Short Bros. and Harland recently. He is seen in this photograph with Rear Admiral Sir Matthew Slattery (right), the chairman, and S/L. W. J. Runciman (left), test pilot, after a flight in a Seamew.

IN BRIEF

The Olympus-Canberra which recently achieved the 65,876ft height record was equipped with a comprehensive range of instruments made by Smiths Aircraft Instruments, Ltd., and Kelvin and Hughes, Ltd. The igniter plugs were supplied by K.L.G. Sparking Plugs, Ltd.

* * *

The Decca Navigator Co., Ltd., announce the formation of a publicity department, to be controlled by Mr. Howard Capes. With offices at 1-3 Brixton Road, London, S.W.9, the department will control all publicity and advertising of the marine, air and survey branches of the company.

* * *

Birmid Industries, Ltd., Smethwick, give news of three new directorial appointments. Mr. J. W. Berry becomes joint managing director of Birmingham Aluminium Casting (1903) Co., Ltd., and Mr. G. A. Rider commercial director of that company. Mr. H. Goodwin is appointed to joint managing director of Birmetals, Ltd.

* * *

A particularly informative review of the nature and uses of Fibreglass-reinforced plastics has lately been published by Fibreglass, Ltd., Ravenhead, St. Helens, Lancs. Apart from tabulated data on the characteristics of the various materials, there are concise, lucid and clearly illustrated descriptions of various moulding techniques.

* * *

A new fueller, the "Cornwall," has been developed by the British Petroleum Co., Ltd., for the B.P. Aviation Service. The fueller can dispense either gasoline or kerosine fuels at up to 500 gal/min, with delivery pressures of up to 50 lb/sq in. It has a bulk capacity of 3,400 gal, which can be increased to 5,900 gal by addition of a trailer. Fine-particle filters are fitted.

* * *

Aluminium Laboratories, Ltd., of Banbury, announce that Mr. A. W. Brace has taken charge of surface-finishing activities in their chemical division. In 1948 Mr. Brace joined the Aluminium Development Association, where he was primarily concerned with the development of techniques for driving large aluminium rivets; subsequently he specialized in surface-finish and production problems.

* * *

Two new directors have been appointed to the Board of Oldham and Son, Ltd., of Denton, Manchester. They are Messrs. Orlando Oldham and P. James Brocklehurst. Mr. Oldham, who is 28 years of age, served for three years in the Fleet Air Arm, spent a year in the Oldham works, then went to the Harvard Business School, where he graduated as a Master of Business Administration. He subsequently worked in various departments at Denton. Mr. Brocklehurst, 32, who served in the Army and subsequently in the family firm of C. Brocklehurst and Son, was admitted a junior partner to Oldhams in 1949.

CIVIL AVIATION

The African sun shines on G-ANBC, third production Britannia, seen in transit during its second proving flight to Johannesburg. The famous signpost in the foreground identifies the setting—Eastleigh Airport, Nairobi.

ELECTRAS FOR E.A.L.

ONE of the biggest single orders ever placed by an airline operator was announced this week by Eastern Air Lines. The order, placed with the Lockheed Aircraft Corporation, is for 40 Electra turboprop airliners and 10 L.1049G Super Constellations. The contract also includes an option on 30 more Electras, which, if taken up, will bring the total value of the order to about 125 million dollars (nearly £45m).

This announcement supports Lockheed's hope that the Electra will become standard equipment on all major United States domestic routes. E.A.L.'s contract was signed nearly three months after American Airlines placed the first Electra order—for 35 aircraft. In the case of A.A. the new aircraft was chosen primarily as a replacement for their company's 75 Convair 240s and Eastern presumably selected it as the successor to their 60 Martin 4-O-4s; the capacity of the Electra will also enable it to take over from DC-4s, DC-6s and Constellations. These orders account for two of America's four major domestic airlines; of the other two, T.W.A. are regarded as likely purchasers of the Electra, but little is known of U.A.L.'s plans.

The Electra is expected to have a cruising speed of about 410 m.p.h. and a maximum stage-length of 1,850 miles. The Eastern Air Lines version will be equipped to carry 66 first-class or 91 tourist passengers. The design is based on the 3,750 h.p. Allison 501 turboprop, though Eastern have not yet decided on their choice of powerplant. Two weeks ago it was announced by Allison that American Airlines had placed a £4.5m order for Model 501 turboprops, after a survey of "all available engines." The first of three Electra prototypes is due to make its maiden flight in October 1957 and deliveries of certificated production Electras to American Airlines are scheduled for August 1958.

AIR KRUISE BUY HERALDS

AN order for "not fewer than six" Handley Page Heralds was announced on September 22nd. The announcement was made by Mr. Eoin C. Mekie, chairman of British Aviation Services, Ltd., parent company of Air Kruise, Ltd., who have chosen the 44-seat Herald to supplement and eventually replace the DC-3s now used on their cross-Channel passenger services and inclusive tours to various Continental destinations.

Other subsidiaries of British Aviation Services are Silver City, Aquila and Britavia. The company's managing director, A. Cdre. G. J. Powell, has described the Herald as ideally suited to the short- and medium-range traffic of Air Kruise: "It can use the smaller airfields on both sides of the Channel yet still has the speed, range and pressurized cabin to take passengers comfortably to the middle and far European resorts."

The announcement states that "the order, as is usual, is conditional upon the new airliner obtaining a Certificate of Airworthiness and successful flight trials." This is the first Herald order to be announced by an airline operator. Handley Page, Ltd., have already announced orders—from Australia and Colombia—for 29 Heralds, with first deliveries due to begin in late 1957.

Air Kruise's re-equipment decision follows an extremely successful season of coach-air services to the Continent, during which the company's DC-3 fleet has grown from one to six aircraft. Flights have been running at a frequency of 75 services weekly, and Air Kruise aircraft have carried over 40,000 people from some 1,200 coaches. The managing director, W/C. Hugh Kennard, reports that "bookings for next year are double all the traffic carried this year. Substantial growth is also foreseen in our scheduled passenger services to Ostend and Le Touquet and in the road-air-rail connections to Paris and Brussels.

"The provision for road- or rail-air connections to Paris," W/C. Kennard adds, "has long been a speciality of Air Kruise. Passengers proceed by road or rail to Ferryfield, are flown across the Channel in 20 minutes and then proceed by the fast expresses of French National Railways to Paris. It is likely that a return fare of £6 or £7 can eventually be offered."

THE ARGONAUT ACCIDENT

FIFTEEN lives were lost when a B.O.A.C. Argonaut crashed and caught fire near Idris Airport, Tripoli, on the night of September 21st. The aircraft, G-ALHL *Altair*, was operating service BA 255 from London to Lagos. Of the 32 survivors, 17 were injured. *Altair* was carrying a full complement of 40 passengers, of whom 13 were killed; the two crew-members lost were a steward and a stewardess.

According to reports, the Argonaut struck some trees ¾-mile from the airport while approaching during a sandstorm; it is stated to have made two previous attempts to land. B.O.A.C. executives and M.T.C.A. investigators flew to the scene of the accident the following day. This is the first fatal accident involving the B.O.A.C. version of the Canadair Four since the fleet of 22 entered service with the Corporation in 1949.

This view of the Boeing 707's spacious flight deck was secured during a recent series of demonstration flights to executives and pilots of Pan American, American and United Air Lines. Up-front on this occasion were A.A.'s director of flight operations, Mr. Walt Braznell (left-hand seat) and, behind him, Mr. Dan Beard, the A.A. vice-president for research and development. Boeing's chief of flight test, "Tex" Johnston, is acting as check-pilot.

As reported below, the twin-Avon-powered S.E. Caravelle is performing well on its flight trials. An order for Air France is thought likely.

CIVIL AVIATION . . .

HELICOPTERS: THE GOVERNMENT VIEW

SOME down-to-earth views on the subject of transport helicopters were expressed by Mr. John Profumo, Parliamentary Secretary to the Ministry of Transport and Civil Aviation, in a speech made last week at Stratford-on-Avon. The provision of air stations (the term "Airstop" has been officially abandoned), Mr. Profumo emphasized, was essentially a matter for local authorities, many of whom had already earmarked suitable sites; he advised caution, however, until the prospects of regular helicopter services became more definite.

A number of problems remained to be overcome before the present experimental services could develop into full commercial services at reasonable fares. If a helicopter fare were calculated on the basis of actual cost very few people would be prepared to pay for it: "We cannot, however, afford to go on subsidizing helicopter operations for ever, and there will come a time when the services, if they are to continue, must be self-supporting."

"If the helicopter is to achieve its full usefulness," said Mr. Profumo, "it must be able to operate right into the centres of cities, and to do this it must be assured of a 100 per cent safety record." Of the noise problem, he said: "Our experience has shown that although people have with time grown used to the noise of trains, buses and other road transport, they will not readily tolerate any further addition to this curse on our civilisation. So the proposed introduction of helicopters into the centre of any city immediately gives rise to a chorus of protests. We clearly cannot ignore such protests, for the main justification for the helicopter is that it will, by providing a new and improved means of transport, contribute a service to the community. I do not under-estimate the seriousness of the problem. Some success has already been achieved."

In the future, said Mr. Profumo, we could look forward to a multi-engined machine capable of carrying 30-40 passengers at a speed of not less than about 150 m.p.h. at a fare somewhat in excess of first-class rail fare—but such a helicopter was still some years off. The helicopter was likely to make its main contribution on distances of 75-250 miles, though this did not mean that, within this field, the helicopter was ever likely to carry the bulk of this traffic. "As far as we can see, trains and buses will always be cheaper to operate and the helicopter will therefore only cater for those who are prepared to pay a little extra to save time."

"Much the same considerations apply," Mr. Profumo added, "in the international field, although the helicopter will be competing more directly with the fixed-wing aircraft. It is probable that helicopter services will be justified on routes such as London - Paris and London - Brussels because the non-stop journey between city centres will save time and be more convenient than the existing air services, even though it may cost more.

"On the other hand if the speed of development in engine and airframe design continues to progress as at present, current thinking may well be revolutionized. The Government is certainly determined to do all that is reasonable to see that the nation as a whole shall reap the full benefit from this new medium of transport at the earliest possible moment."

This 14-seat Heron 2 is one of two in service with the Portuguese Ministry for Colonies. The aircraft are used to link Goa with Karachi and with Damao and Diu, in the other Portuguese settlements in India.

NEW LUFTHANSA ROUTES

LUFTHANSA'S twice-weekly Convair service from Hamburg to Madrid will be extended to Lisbon during the coming winter season. In addition to the existing European international routes, operated with Convair 340s, the airline will also introduce a German domestic network, which will include Stuttgart. For the domestic services, Lufthansa will use DC-3s now under conversion by Transair at Croydon.

LYMPNE REOPENED

WITH the inauguration of Skyways' coach-air service to Paris, reported elsewhere in this issue, the historic grass airfield at Lympne regains its status as a British international airport. Until last year Lympne was operated by the M.T.C.A., and it was used mainly by Silver City Airways as a terminal for their cross-Channel vehicle ferry services. Uncertainty about the future of the airport caused Silver City to build their own terminal, Ferryfield, at Lydd, and the Ministry closed Lympne soon after the opening of Ferryfield.

At the instructions of the M.T.C.A., Lympne was offered for sale by auction last year, but bidding failed to reach the reserve price. Subsequently the airfield was sold to a private buyer, who leased it to Skyways, and a licence for its operation was issued to Skyways in July last.

Operation of the technical services at Lympne—air traffic control, communications and fire and ground rescue facilities—is in the experienced hands of International Aeradio, Ltd., already operating under similar contracts in 30 overseas countries.

Skyways will not be the sole users of Lympne: the airport was recently named as the U.K. terminal of the French company Air-Channel, which has been formed to operate vehicle-ferry services from Le Touquet. This company's existing fleet of three short-nosed Bristol 170s will be augmented next year by three Mk 32 Superfreighters. Services will begin, on a limited frequency, in December next.

BUSY CARAVELLE

ACCORDING to an official French source, flight trials with the twin-Avon S.E.210 Caravelle have been proceeding at an intensity never previously achieved with any comparable prototype. One series of tests, between May 27th and June 20th, involved 18 flights and 24 hr 20 min flying; a second, from August 2nd-11th, entailed 19 flights and 29 hr 13 min flying time. Between August 29th and September 9th, in a third series of tests, the Caravelle is stated to have logged 55 flights and nearly 100 hr.

Take-off trials with one engine cut are said to have given particularly satisfactory results. The aircraft is reported to have shown its ability to meet C.A.A. take-off requirements at more than 83,775 lb, the gross weight originally stipulated for the prototype with its 10,000 lb thrust Avon RA.26s. The production aircraft, with two 11,000 lb s.t. Avon RA.29s, will have a gross weight of 89,700 lb.

During the trials, the Caravelle has reached a height of 38,500ft and a level cruising speed of 435 m.p.h. On one occasion, in a dive, it reached an indicated Mach number of 0.86.

The Caravelle's test crew have been forced, it is said, "to adopt a certain measure of discretion in their radio communications." This follows the discovery that radio messages from the aircraft were being intercepted; details of one flight were broadcast by Radio Lausanne before the Caravelle had touched down at Toulouse, its base.

Pictured at Yeovil the day before its departure for Doha, Persian Gulf, G-AODA is one of two Whirlwinds ordered by the Royal Dutch Shell Group for use in off-shore drilling operations. The 3,000-mile ferry flight, which began on September 20th, was the longest ever attempted by a British-built helicopter.

L.A.P. CENTRAL CRITICIZED—

WRITING in the magazine *Organization and Methods*, Mr. Peter Masefield has criticized the passenger-handling building at London Airport Central on the grounds that it is unsatisfactory for the swift and economical handling of large numbers of short-haul passengers. Mr. Masefield states: "We feel that, although this new building represents substantial advances on the temporary accommodation from which we have had to operate since the end of the war, and although superficially it creates a favourable impression on the general public, yet it unfortunately falls short of perfection from functional points of view in a number of important respects.

"Greater attention to functional requirements without necessarily sacrificing aesthetic appearance would, we feel, have produced a much better result."

—AND DEFENDED

AFTER a 2½ hr tour of London Airport on September 19th, Lord Mancroft, Under-secretary to the Home Office, declared himself "very impressed", adding that he "could see very little room at all for improvement." He inspected both the new central terminal and the old buildings at L.A.P. North; in both places Lord Mancroft found staff working "very efficiently."

PANAM'S DC-7Bs DELIVERED

THE seventh and last of the Douglas DC-7Bs ordered by P.A.A. for their transatlantic tourist services was delivered last week. The first aircraft of this type, which carries 71 passengers and cruises at 335 m.p.h., was delivered and placed in service—on the New York to Paris route—in June. Use of the '7Bs has increased Panam's transatlantic seat capacity by 30 per cent. The next stage of the airline's re-equipment programme will be the delivery, beginning in April, 1956, of no fewer than 33 DC-7Cs. Value of the total order for the 40 new Douglases is given by P.A.A. as £42,857,142, of which some £5m is accounted for by the seven DC-7Bs now in service.

The lengthened radar nose of the first DC-7C Seven Seas (left) is apparent in this recent view of the Douglas assembly hall at Santa Monica. As reported above, the aircraft is due to enter transatlantic service with P.A.A. in April 1956. Wing and fuselage are now joined.

BREVITIES

DELEGATES from the 74 I.A.T.A. member-airlines are attending a traffic conference which began on September 20th at Miami Beach and was expected to continue for three weeks. The conference has been called to settle fares and rates to be charged by I.A.T.A. airlines during the 1956-57 traffic year; some 30,000 fares and rates will be reviewed.

* * *

Tropic Airways, who operate coach-class air services between Johannesburg and Amsterdam, have recently opened a London office at 324 Regent Street, W.1. The company will shortly replace its Yorks with DC-4s.

* * *

Mr. E. P. Hessey.

The appointment of Mr. E. P. Hessey as manager, Africa, for Hunting-Clan Air Transport, Ltd., is stated to reflect the growing scope and importance of H.C.A.'s operations in Africa. In this newly established post Mr. Hessey will be responsible for promoting all the company's African interests, including the new "Africargo" network and the "Safari" passenger routes. Mr. Hessey held a series of senior appointments with B.O.A.C. between 1940 and 1952, when he was seconded to West African Airways as general manager; he left the Corporation last year to become general sales manager of the car division of Armstrong Siddeley Motors, Ltd.

* * *

Work has begun at Karachi on a new engine-overhaul facility for Pakistan International Airlines. Costing £400,000, the base will come into operation next January, though completion is expected to take two years. The airline hopes that in addition to reducing P.I.A.'s own overhaul times and costs, the plant will be used by other operators, making Karachi "one of the major engine overhaul bases in the East."

* * *

The signing of an air-transport agreement between Russia and India was reported on September 20th. No details were given of the terms of the agreement, which was said to have been negotiated between a delegation from Air-India International and members of the Soviet Civil Aviation Board.

* * *

A new London office for Aer Lingus will be opened on October 7th by Mr. W. Norton, Eire's Deputy Premier. Situated at 174, Regent Street, the office replaces the premises shared by Aer Lingus with B.E.A. since July, 1948.

* * *

The new 6,000ft subsidiary runway at Prestwick Airport was due to come into use today, September 30th, 1955. Other constructional work directly associated with the new runway, in particular the new taxiway, is continuing, and should be completed by the spring of 1956.

* * *

Five Austrian airline pilots arrived at the London School of Air Navigation recently to study for their professional licences. Despite their very limited knowledge of English, they were able to sit for the written examination after five weeks' study; each candidate passed in every subject and the average mark was 84.2 per cent.

Service Aviation

EXERCISE "BEWARE"

Illustrated with Sketches by Gordon Horner, "Flight" Photographs

No. 247 Sqn. pilots at Odiham take advantage of a very long lull in their part of the exercise.

THE background to "Beware," this year's major air defence exercise, was outlined by Air Marshal Sir Dermot Boyle, A.O.C-in-C. Fighter Command, shortly before the start of the exercise.

He began by listing three main and equally important factors in air defence under present conditions, namely, early warning, the ability to destroy the bomber, and the deterrent effect of these two factors combined.

An attack would now come without diplomatic warning and the first intimation would be the trace on the radar scope. Immediately the fighters would be sent up, and the strategic bombers and Civil Defence would be alerted. More could be done by C.D. to limit casualties before the bombs dropped than was generally thought. In addition, C.D. officers stationed at control and H.Q. level with the air defences would be able to help in giving notification of bombs dropped, since the target itself would probably be out of touch with the outside world and with its H.Q. Prompt notification would give a good indication of the general objectives of initial assaults.

The Royal Observer Corps would do valuable service by taking over the duty of measuring the strength of radio-active fall-out as it moved with the clouds caused by atomic explosions. This would again be useful in plotting the areas which might shortly be affected and even made untenable because of fall-out.

Present air defence, said the C-in-C., was based upon the manned fighter controlled by radar. A.A. Command had ceased to exist and the only guns were those of the Light A.A. units, most of them manned by territorials.

The attacking forces in "Beware" were to be represented by aircraft of Bomber Command (not including Valiants), and by others from 7th and 49th Air Divisions, U.S.A.F., 2nd and 4th A.T.A.F.s, French Fighter Command, NATO Mediterranean Commands, R.A.F. Flying Training Command and the Fleet Air Arm. American, French, Dutch, Belgian and perhaps Italian aircraft would operate over the British Isles over an area extending from Inverness, down the East Coast and westwards to Plymouth. Though the raiding forces were not quite as large as during last year's Exercise "Dividend" 90 per cent of them would be modern jet aircraft as compared with 75 per cent last year.

Defending forces would, of course, include for the first time a large number of Hunters. One or two Javelins were also to operate on a Service-test basis from an airfield in East Anglia, probably Coltishall, and American F-86Ds would operate from Manston as part of Fighter Command. Since Fleet Air Arm fighter squadrons not otherwise employed were available at all times to reinforce defence forces, a squadron of Sea Venoms which had recently been unable to sail in a carrier would join "Beware" defenders.

Considerable progress, Sir Dermot Boyle stated, had been made with new radar equipment and controlling techniques, even before last year's Exercise "Dividend," and these would again be tried out. Furthermore the continental early-warning chains in 2nd T.A.F. would be "telling" to Fighter Command to extend the range of English networks. Two separate trials of a new aircraft recovery technique would be made.

Since the threat was taken to be atomic, all interceptions would ideally be made at least 30 miles before the bomber crossed the coast. This, the C-in-C. said, would be more difficult with "raiders" in "Beware" than with the potential enemy's present known equipment, since the "raiders" in the exercise would be flying at low weight because of the comparatively

An open-air cookhouse was set up at Odiham to feed crews in dispersals.

A Meteor of No. 600 Squadron lands over the bar lighting at Biggin Hill after a sortie.

S/L. J. Castagnola, the new Commanding Officer of No. 41 Squadron.

(Right) Two Hunter 5s of No. 41 Sqn. land in stream at Biggin Hill after a high-altitude interception. Their results were excellent.

"No trade"—so F/L. Mike Norman of No. 247 Sqn. stoically endures artist's pencil and colleagues' badinage.

short range required, and their performance would therefore be at its best. Some atomic bomb strikes on airfields would be simulated on a purely arbitrary basis, and fighters airborne from an "atomized" base would be diverted.

The activities of "Beware" were to be to some extent co-ordinated with those of an air, land and sea exercise being held concurrently by NATO.

Finally, an actual-weather reporting system had been instituted in Fighter Command so that weather states would be "told" from all bases to a central agency every 15 minutes. Weather forecasts could thereby be accurately checked and bases warned of deteriorations heading their way. Diversion of returning fighters would be much easier and quicker.

Phase One

THE first and outstanding impression of the initial phase of "Beware" is that the new radar techniques and equipment, coupled with the indisputable success of the Hunter as an intercepter, have given Britain a vastly improved air defence. Well over a thousand "enemy" sorties were flown against the U.K. during the first three days, but the rate of interception was very high. Raiders came in at all levels and, while the Hunters took everything above about 40,000ft, the Meteors and Vampires of the Auxiliary squadrons took everything below that height. The Auxiliaries achieved the highest interception rate they have ever had, and the Hunters, in their first large-scale action, proved themselves entirely successful. Their scrambles were very fast indeed, a pair being comfortably airborne some 40 sec after being called out from the O.R.P. at the end of the runway; they reached their operating altitude very quickly and found a comfortable speed margin over everything they had to contend with. Serviceability in most squadrons was also very high.

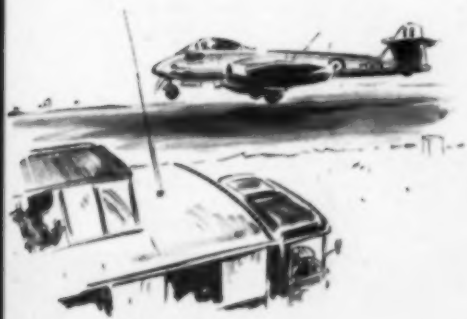
As is always the case, the major part of the activity took place in the control and reporting sections of the Command, while the individual pilots often waited many hours before they were scrambled. No fighter took off from Odiham during the entire morning of Saturday and some squadrons registered only some 15 sorties in a whole day. Once airborne, however, it was evident that the radar apparatus had greatly improved since last year's "Dividend" and, with the additional warning provided by the continental and Scandinavian networks, many of the interceptions took place well over 30 miles out to sea.

Meteors and Venoms still form the backbone of the night fighter force, and they were heavily engaged, but one Javelin was also operating from East Anglia. In two nights it claimed five successful interceptions in four night sorties.

Every type of raider was encountered and many types of rats (low-level intruders), which operated the whole time, proved to be the Auxiliaries' main prey and gave them plenty of sport.

A few atomic strikes on airfields were recorded, but it was the atomic threat in the air rather than damage on the ground which was being simulated, and here the various types of approach to the target had to be countered. The F-84Fs, for instance, used the long high-speed dive to a low-level drop which makes them difficult to track on radar and requires a very high fighter speed for interception. B-47s, B-45s and similar types are now easy meat for Hunters, but it had always to be reckoned that the low-level aircraft might carry the lethal weapon, and these the Auxiliaries had to deal with because of the Hunter's limited endurance at low level.

The first phase of "Beware" was generally encouraging, and it could be expected that by the time the 5,000 reservists had got into their stride the results would be remarkably good by day, with promise of really advanced night-fighters for the not-too-distant future.



(Left) Air Marshal Sir Dermot Boyle lands at Odiham in his silver "three star" Meteor 8 to inspect proceedings.

(Below) The operational readiness platform at Biggin with Hunters of No. 41 Sqn. and Meteors of No. 600 Sqn. on standby.

F/O. Lord Morris, No. 247 Sqn., comments on a sortie.

Four Venoms of No. 266 Sqn., 2nd T.A.F., based at Wunstorf, Germany, go smoothly over the top of a loop in box formation.

SERVICE AVIATION . . .

Exercise "Sea Enterprise"

ON Wednesday last week the carrier task-force exercise "Sea Enterprise" began in the sea area around Norway. It involved the Royal Navy carriers *Eagle, Albion, Centaur* and *Bulwark* and H.M.C.S. *Magnificent*, together with escorts and supply ships. The carriers are on the Blue (friendly) side while the enemy is simulated by aircraft and submarines of the Orange forces, many of them based in Norway.

No. 801 Sqn., F.A.A., normally based at Lossiemouth, flew sorties against the carriers from a Norwegian airfield and was intercepted by Sea Hawks, the attack being based on reconnaissance information gathered by Coastal Command Neptunes, also operating from Norway. Shackletons from Northern Ireland gave long-range anti-submarine cover to the task force as it sailed into the exercise area. Blue air attacks on targets on the Norwegian coast have been met by Royal Norwegian Air Force F-84s.

V.I.P. Visits

KING FEISAL OF IRAQ paid a brief visit to C.F.S., Little Rissington, on Thursday last week. He toured the station and saw various types of aircraft.

On the previous day Mr. Cornelis Staf, Netherlands Defence Minister, had visited Waterbeach, Marham and Horsham St. Faith, flying from Hendon in a Transport Command Devon. At Marham, Mr. Staf attended the briefing of a bomber crew for a practice mission and saw a Canberra being loaded with 500 lb bombs.

No. 100 Sqn. Standard

FIRST of the night bomber squadrons to receive its standard will be No. 100, now flying Canberras from Wittering, Hunts. The standard will be presented at Wittering on October 21st by the A.O.C.-in-C. Bomber Command, Air Marshal Sir George Mills.

No. 100 Sqn. was formed in 1917 as part of the Independent Air Force, which was designed to provide the first strategic air striking force against Germany, and moved straight away from Farnborough to France. First target for their F.E.2Bs was the airfield at Douai from which the Richthofen circus was operating.

In August, 1918, Handley Page twin-engined bombers were taken over and flown against towns in Germany; and on the night before the Armistice the last night bomber to land was one belonging to No. 100 Sqn.

Between the wars the unit continued with bombers and moved out to Singapore in 1933, with torpedo-bombers. Vildebeestes were flown against the Japanese until 1942 and heavy losses were sustained. The unit was reformed in England at the end of that year with Lancasters, and attacks were made on Peenemünde, among other targets; later the squadron supported the Normandy landings. The last operational sortie was against the S.S. barracks at Berchtesgaden.

During World War 1 the squadron flew 213 sorties and dropped 185 tons of bombs and during World War 2 it made 3,000 sorties and dropped 17,500 tons.

The battle honours chosen for the standard are Ypres, 1917; Somme, 1918; Independent Air Force and Germany, 1918; Malaya, 1941-1942; Fortress Europe, 1943-1944; Ruhr, 1943-1945; Berlin, 1943-1945; Normandy, 1944.

C.A.S. in U.S.A.

LAST week Air Chief Marshal Sir William Dickson, Chief of the Air Staff, visited Washington for discussions with Gen. Twining, Chief of Staff of the U.S.A.F. It is understood that one of the subjects discussed was the growing share which Bomber Command could now begin to take in keeping up the global striking force at present solely manned by Strategic Air Command. There has always been close understanding and co-operation in this field, but only now is the R.A.F. able to contribute its own long-range fast bombers to the scheme.

Sir William, in a New York statement, denied a London report that he had advocated a unified command. "It is premature to consider anything like that," he said.

Canadian F2H Banshees

TECHNICIANS of the Royal Canadian Navy are at present at the U.S. Navy air base at Cecil Field, Florida, learning to maintain the McDonnell F2H-3 Banshee single-seat all-weather fighters which will form the equipment of the first Canadian Naval jet squadron, designated VF-870.

Normally based at H.M.C.S. *Shearwater*, Dartmouth, Nova Scotia, the squadron is to embark in H.M.C.S. *Bonaventure*, the new carrier, after she is commissioned at the end of next year.

No. 234 Squadron

IT is proposed to place on record the history of No. 234 Squadron, now with 2nd T.A.F.

The Commanding Officer, S/L. R. E. Emett, A.F.C., would be pleased to hear from ex-members of the unit, particularly from those who served during the periods from 1939 to 1946 and from re-forming in 1952 to the present day. Another period for which information is sought covers the latter period of the 1914-18 war.

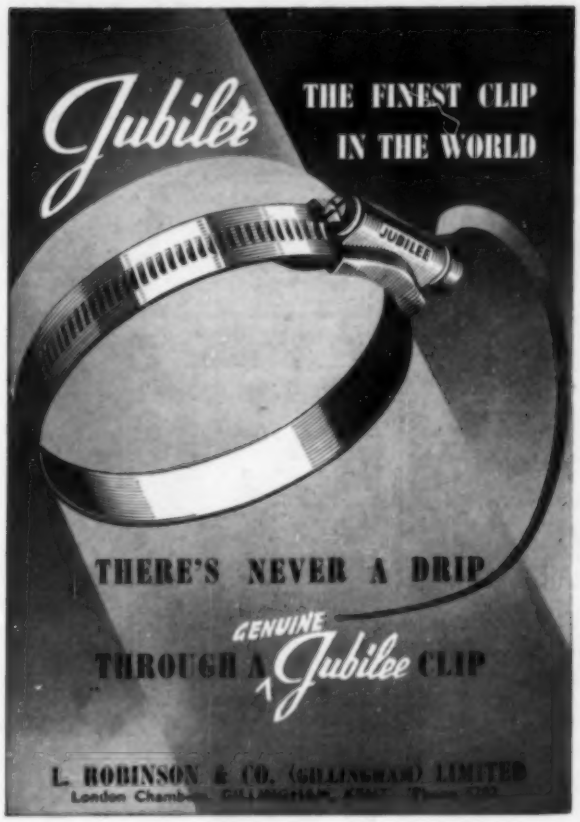
Photographs and matter should be addressed to S/L. Emett at No. 234 Squadron, R.A.F., 2nd T.A.F., B.A.O.R.1.

Reunions

THE tenth annual reunion of No. 85 Sqn. will be held at the R.A.F. Reserves Club, London, W.1, on November 12th. Particulars from J. Roberts, 14, Carisbrook Close, Enfield, Middx.

No. 150 Sqn. annual reunion will be held on October 15th at the Swiss Hotel, 53, Old Compton Street, London, W.1. Tickets, price 6s 6d, obtainable on application to L. E. Hodgson, The Cottage, 12, Waldgrave Road, Bickley, Kent.

First view of an Auster A.O.P.9 in service. It is here being flown over the Malayan jungle near Ulu Langat, Selangor, by Maj. A. F. Robertson, R.A., commander of No. 656 A.O.P. Light Liaison Flight. The picture was taken on the tenth anniversary of the flight's arrival in Malaya, and during the A.O.P.9's first sortie when leaflets were dropped to the terrorists.



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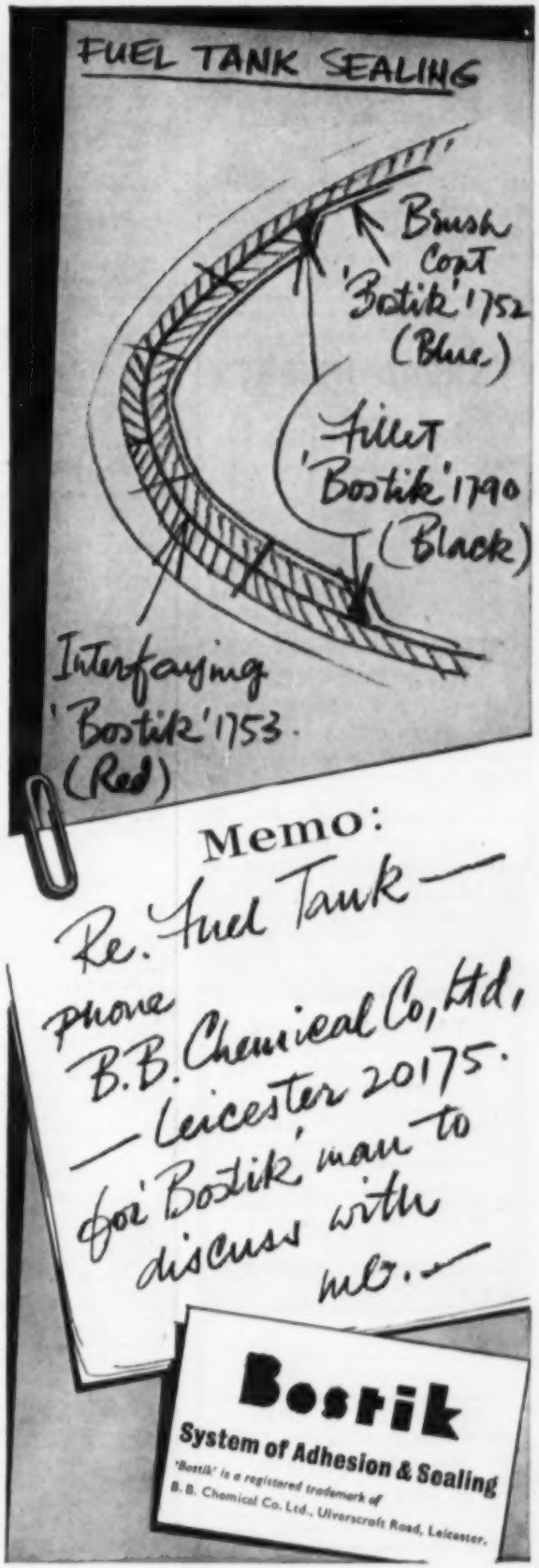
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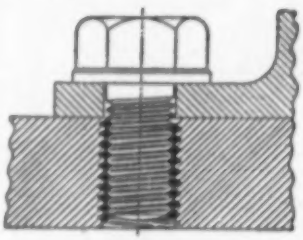

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the undermentioned applications to operate scheduled air services:

FROM Eagle Aviation, Ltd., of 29, Clarges Street, London, W.1, for the following Seasonal Inclusive Tour Services for the carriage of passengers and supplementary freight, for a period of seven years:

APPLICATION No. 615. For a service with Viking aircraft in conjunction with Sir Henry Lunn, Ltd., between London (Blackbushe) and San Sebastian at a frequency of two return flights weekly during the season from May to October inclusive each year from 1st May, 1956, to be operated mid-week from Monday to Friday.

APPLICATION No. 616. For a service with Viking aircraft in conjunction with Sir Henry Lunn, Ltd. between London (Blackbushe) and Naples (Capodichino) at a frequency of two return flights weekly during the season from March to October inclusive each year from 1st March, 1956, to be operated on Thursday and Sunday.

APPLICATION No. 617. For a service with Viking or Dakota aircraft in conjunction with Sir Henry Lunn, Ltd. between London (Blackbushe) and Cannes or Nice at a frequency of four return flights weekly during the season from March to October inclusive each year from 1st March, 1956, to be operated on Saturday or Sunday.

APPLICATION No. 618. For a service with Viking aircraft in conjunction with Sir Henry Lunn, Ltd. between London (Blackbushe) and Geneva at a frequency of four return flights weekly during the season from May to October inclusive each year from 1st May, 1956, to be operated from Monday to Friday.

APPLICATION No. 620. For a service with Viking aircraft in conjunction with See Spain, Ltd. between London (Blackbushe) and Basle at a frequency of one return flight weekly during the season from April to October inclusive each year from 1st April, 1956, to be operated on Saturday or Sunday.

APPLICATION No. 623. For a service with Viking or Dakota aircraft in conjunction with Lewis A. Leroy, Ltd. between London (Blackbushe) and Luxemburg at a frequency of six return flights weekly during the season from April to October inclusive each year from 1st April, 1956, to be operated on Saturdays and Sundays.

FROM Starways, Ltd., of Liverpool Airport, Liverpool, 19, for the following Seasonal Inclusive Tour Services to be operated with Dakota aircraft for the carriage of passengers in conjunction with Cathedral Touring Agency during the season from May to October inclusive each year for a period of seven years, from May, 1956:

APPLICATION No. 619. For a service between Liverpool (Speke) and Deauville at a frequency of two to six return flights weekly to be operated on Wednesday and Saturday.

APPLICATION No. 624. For a service between Liverpool (Speke) and Dinard at a frequency of three return flights weekly, to be operated on Sunday.

APPLICATION No. 625. For a service between Liverpool (Speke) and Jersey at a frequency of three return flights weekly, to be operated on Sunday.

FROM Air Kruise (Kent), Ltd., of 1, Great Cumberland Place, London, W.1, for the following Seasonal Inclusive Tour Services to be operated with Dakota aircraft for the carriage of passengers for a period of seven years:

APPLICATION No. 621. For a service in conjunction with Fourways Travel, Ltd. between Lydd and Luxemburg at a frequency of four return flights weekly during the season from May to September inclusive each year from May, 1956, to be operated on Sunday, Tuesday, Thursday and Saturday.

APPLICATION No. 622. For a service in conjunction with Lewis A. Leroy, Ltd., between Lydd and Luxembourg at a frequency of three return flights weekly during the season from April to October inclusive each year from April, 1956, to be operated on Friday, Saturday, Sunday, or Monday.

FROM Lancashire Aircraft Corporation, Ltd., of 7, Berkeley Street, London, W.1, for the following Seasonal Inclusive Tour Services to be operated with Dakota aircraft for the carriage of passengers and supplementary freight in conjunction with The Peoples Travel Agency, Ltd., for a period of seven years:

APPLICATION No. 626. For a service between Blackpool (Squires Gate) and Dinard at a frequency of one return flight weekly during the season from the end of May to September inclusive each year, from 28th May, 1956.

APPLICATION No. 627. For a service between Blackpool (Squires Gate) and Biarritz at a frequency of up to four return flights weekly during the season from May to October inclusive each year, from 6th May, 1956.

APPLICATION No. 628. For a service between Blackpool (Squires Gate) and Ostend at a frequency of four return flights weekly during the season from May to September inclusive each year, from 25th May, 1956.

APPLICATION No. 629. From B.K.S. Air Transport, Ltd., of 1, Marylebone High Street, London, W.1, for a Seasonal Inclusive Tour Service to be operated with Dakota and Viking aircraft in conjunction with Sky Tourist Services, Ltd. for the carriage of passengers and supplementary freight between Southend and Munich at a frequency of one return flight weekly, operated on Thursdays, during the season from April to October inclusive each year for a period of seven years, commencing 1st May, 1956.

(*Continued at top of column 3, page 25*)

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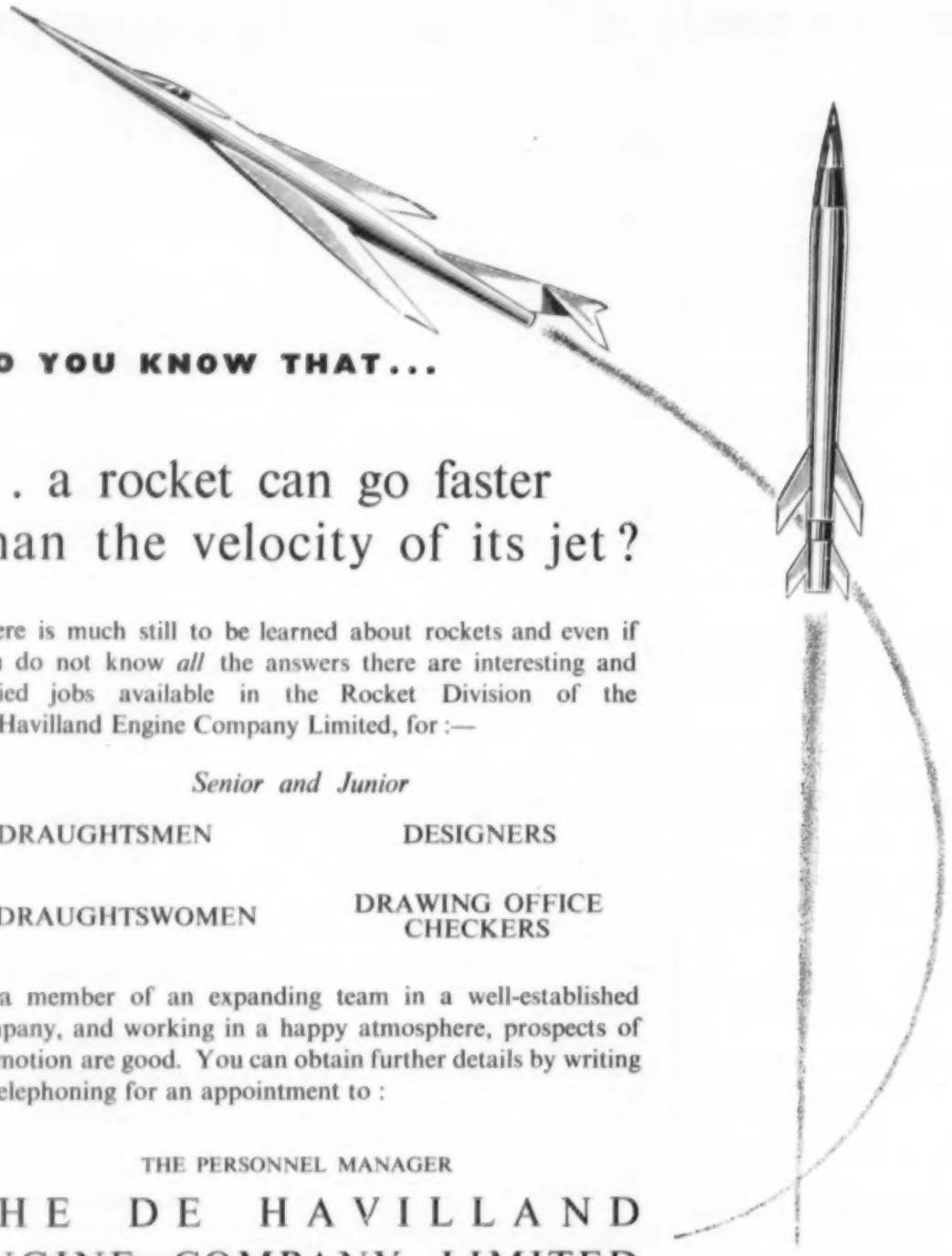

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PUBLIC ANNOUNCEMENTS

(Continued from column 2, page 23)

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections.

THE Air Transport Advisory Council also give notice that the following applications have now been withdrawn:

APPLICATION No. 555 from B.K.S. Air Transport, Ltd., of 1, Marylebone High Street, London, W.1, for a Seasonal Inclusive Tour Service in conjunction with Sky Tourist Services, Ltd., between Southend and Cologne.

APPLICATION No. 606 from Eagle Aviation, Ltd., of 29, Clarges Street, London, W.1, for a Seasonal Inclusive Tour Service in conjunction with See Spain, Ltd. between London (Blackbushe) and Milan.

THESE applications were advertised in "The Times", "The Aeroplane" and "Flight" on 12th August, 1955, and 16th September, 1955, respectively. [4280

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BLACKBURN & GENERAL AIRCRAFT, LTD., Brough, E. Yorks, require a Statistician for work in their main Production Office. The duties consist of compilation of statistics relating to the large scale production of transport aircraft. A good opportunity exists for a competent man.

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RADIO "B" Licensed Engineer to take over fully equipped and operating radio overhaul workshop for leading British independent airline. Knowledge of aircraft radio installation work preferable. Interesting and responsible job with considerable future in rapidly developing company. Salary according to qualifications. Apply Box No. 6309. [4217

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THE Wolverhampton branch of a world-wide industrial organisation offers permanent position with excellent prospects of promotion for both senior and junior staff as Technicians and Design and Detail Draughtsmen on interesting design and development work in connection with atomic energy, aircraft, guided weapons and industrial engineering projects.

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CHIEF DRAUGHTSMAN. A man with aircraft and electronic or guided weapon engineering experience is required to supervise a Design Office in London. Applicants must be capable administrators and should preferably have held a similar position. Write in confidence, giving full details of age, qualifications and past experience to Box A.C.11468, Samson Clarks, 57-61 Mortimer Street, W.1. [4234

THE COLLEGE OF AERONAUTICS. Designer Draughtsman required in the Installation Section of the Department of Aircraft Propulsion. Applicants should have experience of Engine Test Beds and Research Projects. H.N.C. or equivalent preferred, 5-day week, four weeks leave per year excluding Bank Holidays. Salary up to £750 per annum according to age, qualifications and experience. Application forms from Chief Clerk, The College of Aeronautics, Cranfield, Bletchley, Bucks. [4271

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A. V. ROE & CO., LIMITED, have a vacancy in the Flight Research and Development Department at their Woodford Aerodrome for an engineer to be responsible for structural flight tests. Applicants must have a good scientific background and first-hand experience of modern methods of structural testing. Willingness to fly is an essential qualification. This is a new post, created by the expansion of the Department, and offers excellent prospects to a suitably qualified man. Applications stating age, past experience, etc., to the Chief Superintendent, Flight Research and Development, A. V. Roe & Co., Limited, Woodford Aerodrome, Cheshire. [4211

BRITISH EUROPEAN AIRWAYS require a Technical Assistant, Project and Development Branch, London Airport. Qualifications: good 2nd Class Degree or equivalent in Engineering, Physics or Mathematics. Experience of performance requirements, preparation of flight manuals and/or special training in statistics desirable. Salary scales £717 10s.—£767 10s. p.a., or £742 10s.—£867 10s. p.a. according to qualifications and experience. Pension scheme, sick-pay, air travel concessions in Europe, 3-weeks' annual holiday. Written applications, giving full particulars, to Senior Personnel Officer, B.E.A. Engineering Base, London Airport, Hounslow, Middlesex. [4282

TECHNICIANS

Graduates in engineering or physics are required by Armstrong Whitworth for interesting work associated with guided weapon flight trials. Applicants are required to work on the development of environmental testing techniques and on the development of suitable equipment to simulate a wide range of operating conditions.

Technical Assistants are also required for the same work. Here, either Ordinary or Higher National standard is required, and the work will consist mainly in operating the equipment described above.

For all of these posts experience of development testing or type testing would be an advantage, and some experience in operating electrical and electronic equipment would be desirable. Some of the posts entail occasional visits to the missile firing ranges.

All applications should be addressed to the

Staff Employment Officer, Armaments Division,

Sir W. G. Armstrong Whitworth Aircraft Ltd.

Whitley, Nr. Coventry.

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Staff Employment Officer, Box No. 6581, c/o "Flight"

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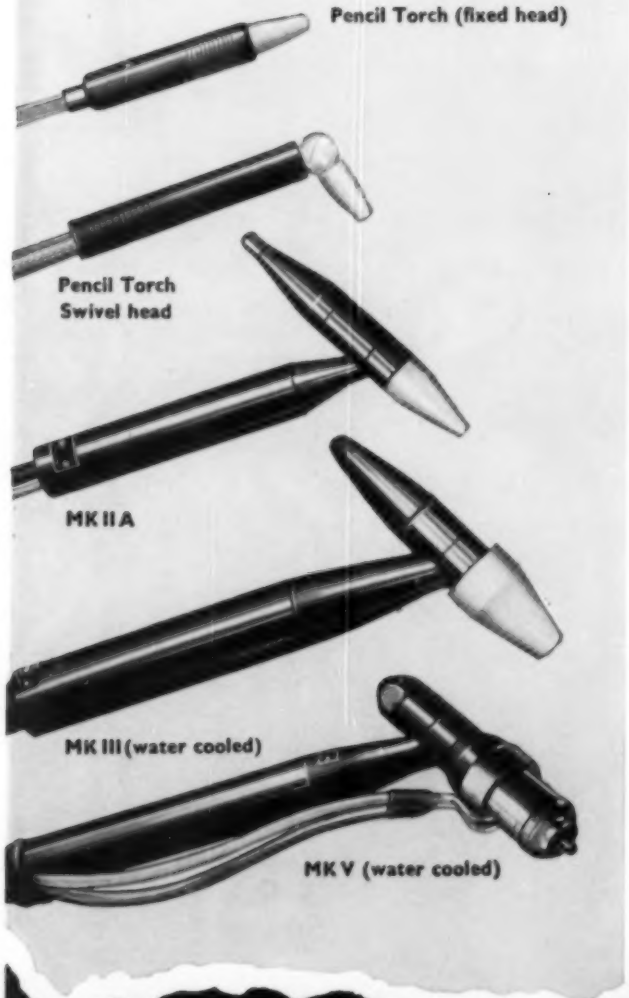

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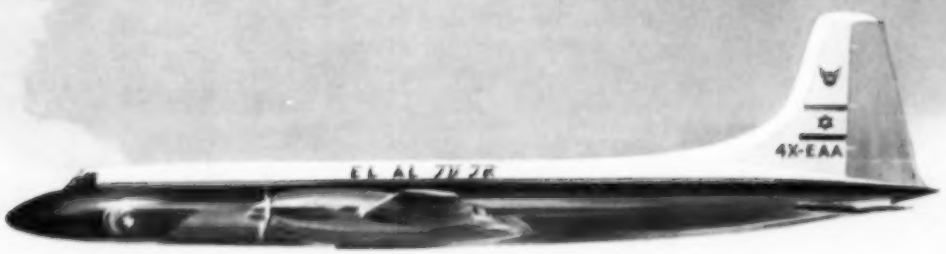

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